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ADULTERATIONS OF ESSENTIAL OILS.

By Dr. Geo. R. Pancoast and Lyman F. Kebler.

In early times technical equipments for the production of volatile oils were very incomplete, and various expedients were necessarily resorted to for the purpose of extracting the many odorous principles from the host of plant tissues; fatty products, turpentine and alcohol were frequently employed for this purpose, and consequently there was a certain justification formerly for the presence of some of these solvents in certain essential oils. But modern methods render the use of these foreign substances entirely unnecessary and they must be looked upon as adulterations pure and simple.

Adulteration is chiefly resorted to on the one hand because of its profitableness, and on the other hand because of the ignorance of the consumer and his desire to purchase as cheaply as possible. The latter frequently does not seem to care for quality, but wants quantity. It is often due to this that an honest producer may be induced to offer spurious goods, because he cannot get reasonable prices, while his competitor is able to dispose of large quantities of adulterated oils. It must not be forgotten that formerly the adulterator could ply his art fearlessly without much danger of exposure, and this probably emboldened him. To-day he is compelled to act a little more cautiously owing to the developments of the chemistry of terpenes and their derivatives, as well as a more or less complete knowledge of the composition of a number of the volatile oils. The "Black Art" of volatile oils is passing away.

The writers are fully convinced that the large distillers and reputable wholesalers are not responsible for some of the adulterated oils met with, even though they pass through their hands.

They are generally beyond their control, as will be seen by some of the subsequent remarks.

The guileless farmer or peasant who constructs a crude still and collects oils by his primitive methods (besides the impurities to be expected from this source) frequently adds a goodly proportion of a cheaper oil or synthetic sent to him by a friend in the wicked city. Synthetic oil of wintergreen is said to be largely used in this manner, and the resulting product sold for true oil of wintergreen.

The Turkish peasant in like manner and for similar reasons adds geranium oil to his rose leaves before he begins his distillation of pure otto of rose. Even John Chinaman, forced to keep "open door," manages to return the "Foreign Devils" coal oil by conscientiously "plugging" some of the essential oils which he sells, especially oils of aniseed and cassia. And the warm-blooded Sicilian, in response to an increasing demand for his goods, rejuvenates a worn-out or poor quality oil by adding the necessary constituents taken from a cheaper source; for example, oil of lemon is fortified with citral obtained from oil of lemongrass, and oil of bergamot is "pieced out" with lemon and orange oils.

Then some of the primitive distillers themselves, and possibly some of the middlemen or the jobbers, try their hands at improving nature. This is practiced in some instances to such an extent that the farther the oil travels, and the larger the number of hands it passes through, the more it adds unto itself, until finally, in some instances, at least, it is not recognized by its friends. Some of these adulterations may be due to ignorance, carelessness or accident, but many, very many, are due to design, and unless there is some improvement in this respect, we may be prepared to hear in the near future of some one liberally supplying himself with synthetics, esters, aldehydes, alcohol, oil of copaiba and plenty of French turpentine, then opening up an office with the sign "Essential Oils Made to Order While You Wait."

Essential oils are frequently met with that are unnaturally low in their characteristic constituent, so much so that, being otherwise satisfactory, only one conclusion can be drawn, viz., that they have been robbed or looted; for example, de-mentholized peppermint oil; oil of cloves, minus a large part of its eugenol; caraway, deprived of some of its carvone; and oil of lemon, abnormally low in its citral. We shall hereafter for brevity's sake call this class of

oils "looted oils." By such tactics a double profit is made by the manipulator. The consumer in these cases makes two purchases where he should make but one and save money by so doing; as for instance, he buys eucalyptol and a cheap oil of eucalyptus; then, in order to make the oil answer the proper requirements, it is necessary for him to use the eucalyptol to strengthen his inferior oil of eucalyptus.

Another matter not generally known is that certain manufacturers claim that some absolutely pure oils need to be modified so as to conform to some arbitrary standard; for example, one very prominent and reliable house lists oil of pimento at $2.10 per pound, but oil of pimento said to be made to meet the requirements of the U.S.P. is offered at $1.60. The same criticism is applied to the U.S.P. requirements for oils of bay and coriander.

Among the favorite articles used as adulterants, and to be looked for, are cheaper essential oils (turpentine, copaiba, cedarwood and gurjun balsam), alcohol and fixed and mineral oils.

PRELIMINARY TESTS.

(1) Physical appearance.

(2) A common method and a very useful one is that of exposing a drop or two of the oil on white glazed paper, and from time to time observing the odor. By this means alone, in many cases, a cheap oil can be detected, especially turpentine. Lemon and orange require from twelve to fifteen minutes; bergamot, two to four hours; lavender, twelve to fifteen hours; cloves, twenty-five hours; and sandal wood, two days, for comparison. Fixed oils leave a permanent greasy stain. Results by the above procedure give only indications, which must be verified by established methods.

Alcohol.—Several tests can be applied to give indications of the presence or absence of alcohol. Oils free from alcohol (acetone or purified wood alcohol), when dropped into water, remain transparent, but the presence of alcohol causes the globules to become opaque or milky. When a considerable amount is present, it may be approximately estimated by placing a given volume of the oil into a graduated cylinder, adding an equal volume of water, agitating well, and then setting aside until complete separation results. If there is any appreciable diminution in the volume of oil, alcohol (acetone, acetic ether or purified wood alcohol) is present. The

diminution of volume is generally proportional to the amount of adulterant. Glycerin can be used in place of water.

In order to positively establish the presence of any of the above, fractional distillation must be resorted to and the substance finally identified by means of the iodoform reaction, boiling point, etc.

CHEAPER ESSENTIAL OILS.

Turpentine generally introduces abnormalities, lower specific gravity, diminished solubility, lower boiling temperatures and disturbed optical rotation. The latter can easily be remedied by mixing the proper proportions of dextrogyrate and lævogyrate turpentines. Before a positive opinion can be given relative to the presence of added turpentine, in many cases a careful comparison must be made and the characteristic derivatives of pinene isolated.

Cedarwood, copaiba and gurjun balsam oils are generally indicated by their lesser solubilities, higher specific gravities and optical rotations, but the two latter can readily be adjusted by the proper kind and amount of turpentine.

Mineral oils (petroleum, kerosene, etc.) are generally revealed by their insolubility and indifference to the action of strong acids and alkalies. They may be variously isolated, by their insolubilities, polymerizing the oil with concentrated sulphuric acid and then distilling the mixture with aqueous vapor, or by oxidizing with fuming nitric acid and then removing the oxidized portion with hot water, thus leaving the unaffected petroleum behind.

DETERMINATION OF PHYSICAL PROPERTIES.

The *specific gravity* is one of the best known properties of oils and is the one most generally applied because it is readily determined. The specific gravity is a very important factor, but is readily tampered with, consequently very careful deductions based on it must be made.

Solubility.—Very definite and satisfactory data have been established for many oils relative to their solubility; so much so that this physical property is probably more reliable than any other single one. The common adulterants are generally revealed by the application of this test. The volatile oils are quite readily soluble in alcohol, ether, acetone, acetic ether, glacial acetic acid, carbon disulphide, chloroform, benzol, petroleum ether and paraffin oil.

The *optical rotation* is exceedingly valuable, frequently being the only means by which the purity of an oil can be arrived at, and should never be omitted.

Fractional distillation is usually resorted to in cases of admixture.

The *congealing point* is especially useful and necessary with anise oils.

QUANTITATIVE ESTIMATION OF CONSTITUENTS.

Before an oil can be submitted to a chemical examination, it is necessary to know at least its chief constituents, and then the methods must be so adjusted that these constituents can be estimated quantitatively with a considerable degree of accuracy. Such methods have been elaborated only within recent times, and are based on well-known organic reactions.

The oldest and probably the most useful is the method of *ester determination* or *saponification*. It was originally applied to essential oils as we now apply it to fixed oils, and is based on the fact that fixed alkalies resolve the esters into their respective alcohols and acids, the alkalies combining quantitatively with the latter. Then, knowing the ester in a given oil, the amount can readily be calculated by the quantity of alkali consumed by a given weight of oil. The linalyl acetate of lavender and bergamot oils is readily estimated by this process.

Aldehydes.—In the case of aldehyde-bearing oils, as cassia, the property of sodium bisulphite forming a compound soluble in water, containing an excess of sodium bisulphite, is utilized. This process is of much practical value with oil of cassia, and the oil is now generally purchased on the basis of aldehyde content.

Acetylization.—Many of the oils contain alcohols as essential constituents. These can mostly be estimated by converting them into acetic esters, by means of acetic anhydride, removing water-soluble products by washing with water, then dehydrating the residue by means of fused sodium sulphate, and estimating the amount of acetyl group contained in a given weight of the acetylized oil.

PHENOL DETERMINATION.

It is the custom in France to rectify oil of thyme with considerable quantities of turpentine oil. The original cause of this procedure is probably due to the fact that the consumer requests a colorless oil, and oil of thyme contains a goodly per cent. of phenol

bodies, which cause the freshly distilled oil to develop a coloration in a short time. The smaller the amount of phenol, the longer the oil will remain colorless. Careful analyses of this oil show that a pure product contains about 25 per cent. of phenols, and these can be approximately estimated by treating a given volume of oil with a 5 per cent. solution of sodium hydroxide, in a burette, and noting the diminution of volume of the oil. The alkaline solution forms soluble compounds with the phenols.

The following comprises a list of oils and the impurities found in them by various observers, as well as the writers:

Almonds, bitter, true.—There are no objections, so far as the writers know, to the preparation of a so-called oil of bitter almonds made from apricot or peach kernels, but it ought not to be offered as the genuine article. The true oil is often adulterated with alcohol, nitrobenzol, turpentine and benzaldehyde, the latter sometimes *in toto.*

Aniseed, spermaceti up to 35 per cent., alcohol as much as 80 per cent., kerosene, wax, oils of fennel, cedar, copaiba, camphor, turpentine, fennel stearoptene and oil of caraway, obtained from both the seed and the chaff.

Angelica, copaiba.

Amber, crude, resin mixed with coal oil and turpentine. It is rumored that crude petroleum is frequently supplied for this article.

Amber, rectified, resin oil, turpentine and kerosene. Note remarks made under amber, crude.

Bay, cloves, pimento, turpentine and oils containing phenols. It has also been adulterated with redistilled oil of cinnamon leaf, with a slight admixture of redistilled oil of lemongrass. Such an article has been pronounced by those of little experience superior to the pure product, appearing sweeter, more aromatic and not as heavy in odor as a pure oil.

Birch, methyl salicylate, and there is no absolute method to detect it.

Bergamot, lemon, orange, French turpentine, linaloe, fatty oils.

Cajeput; this is often *looted.* A mixture of rosemary or savin with camphor and resin of milfoil is often substituted. Oils of camphor and turpentine must be looked for.

Cajeput, Formosa, said to be a mixture of cajeput and oil of camphor.

Camphor, benzine, coal oil, turpentine, one case 25 per cent.

Canada snakeroot, copaiba.

Cananga, coca nut oil.

Cassia, coal oil, fatty oils, resin (one case 18 per cent.), oil gurjun balsam, cloves, cinnamon leaf, cedarwood. A 90 per cent. aldehyde containing oil of cassia reduced to a 70 per cent. strength oil, by the addition of enough coal oil. A large profit in coal oil.

Caraway seed, often a looted oil; turpentine, oil of caraway chaff and added limonen. The term "twice rectified" for this article is rather misleading, as each rectification reduces the percentage of carvol. The single distillation of Dutch caraway seed produces a superior oil and of much greater strength than the so-called "twice rectified."

Cedrat, a mixture of orange and bergamot.

Cedar, hemlock, spruce, turpentine, oil of camphor.

Cedar leaf, cedarwood, thuja.

Celery seed, celery leaf, turpentine.

Chamomile, cedar, copaiba, turpentine, milfoil, lemon. The manufacturer sometimes distils lemon or turpentine over his chamomile flowers.

Cinnamon, cloves, cassia.

Citronella, Japanese oil of camphor, the light variety. This article was preferred by some, as it had a sweeter odor. Fatty oils, oil of gurjun, coal oil, coca nut oil. A controversy occurred in England as to whether a mixture of citronella 35 per cent., lemon 10 per cent. and coal oil 55 per cent. could pass as citronella oil.

Coriander, orange, cubebs, cedar, turpentine. Oil of orange distilled with coriander.

Copaiba, oil gurjun balsam.

Cloves, clove stems, fatty oils, copaiba, pimento, coal oil, turpentine and carbolic acid. A looted oil is sometimes met with.

Cubebs, copaiba.

Curaçoa orange, bitter orange and bergamot.

Dill, caraway chaff oil, mace, turpentine.

Eucalyptus, looted oil, cheaper grades of eucalyptus. Turpentine is said to smooth a rough oil.

Fennel seed, looted oil, fennel chaff, alcohol, oils containing phenols.

Geranium, gingergrass, rectified citronella, fatty oils.

Geranium, Turkish, fixed oils, turpentine, coal oil.

Gingergrass oil, mineral oil and turpentine.

Hemlock, spruce, turpentine.

Juniper wood, turpentine.

Lavender, garden, spike, oil of camphor, turpentine.

Lavender flowers, turpentine, alcohol. A poor oil is sometimes found "plugged" with ester. According to Schimmel, the test for solubility, one part to three of 70 per cent. alcohol, does not prove or disprove the presence of turpentine. The method of distillation is responsible in the majority of cases for the variations in specific gravity, optical rotation and solubility.

Lemon, poor lemon oil, with citral from lemongrass added, poor or old orange oil, turpentine. When testing on paper, use a piece of fresh lemon peel for comparison.

Lemongrass, fixed oils.

Limes, expressed, lemon.

Melissa, lemon, citronella or lemongrass distilled over melissa leaves. Mixtures of lemon and citronella or lemongrass.

Matico, alcohol, turpentine.

Mace, distilled, poor quality nutmeg oil.

Neroli, petit-grain, with a little bergamot, improves the quality of a poor oil. Lemon or orange increase optical rotation. Petit-grain or linaloe decrease optical rotation.

Orange, alcohol, turpentine. When testing on paper, use orange peel for comparison.

Origanum, a mixture of thyme, oil of camphor, turpentine and coloring matter; crude oil of sassafras, rectified resin oil, Barbadoes tar, crude petroleum.

Palmarosa, coca nut oil, petroleum.

Patchouli, cedarwood, cubebs, turpentine, coal oil.

Peppermint, mixture (peppermint, glycerin, alcohol and turpentine) copaiba, erigeron, turpentine, castor oil, pennyroyal, alcohol, glycerin, oil of camphor, sassafras, looted oil.

Pennyroyal, de-mentholized mint, turpentine, alcohol, residue from peppermint distillation.

Petit-grain, turpentine.

Pimento, cloves, carbolic acid.

Pine-needle oil, turpentine. Much confusion exists in these oils, due partly to the nomenclature of the coniferæ.

Pinus Sylvestris, Scotch oil of fir, coal oil, turpentine. Very little genuine is to be had.

Rose.—The leaves of rosa alba added to the Bulgarian rose, as the oil from this mixture contains more stearoptene, so that the distiller is able to add more geranium oil without reducing the melting point below the minimum. Indian geranium or ginger-grass, palmarosa, true oil of rhodium, light paraffin oils, fixed oils, guaiac wood oil, alcohol, spermaceti, paraffin. This is the record breaker for number of adulterations.

Rhodium, a mixture of rose and copaiba.

Rosemary, camphor and lavender, turpentine, spike oil, petroleum oil, alcohol, rectified camphor oil.

Rue, turpentine, coal oil.

Sandal, "*German*," mixture of sandal-English and copaiba.

Sandal, "*East India*" *or* "*English*," castor oil, copaiba, fatty oils, cedarwood, oil of gurjun, West India sandals. Chloroform and alcohol were found in one sample that is said to have answered the U.S.P. requirements. This oil should be from one to two years old, as ageing considerably improves the fineness of the aroma. The U.S.P. requires a specific gravity 0·970 to 0·978. Ten observers, including Schimmel, Umney, Parry, Bush and Squires, average 0·971 to 0·979. Optical rotation, — 12° to — 20°; santalol, from 86 to 98 per cent.

A safe average for a good oil would be, optical rotation, from — 17° to — 19°; specific gravity, 0·975 at 15° C.; and santalol at least 90 per cent. A lot of oil made by a certain firm had a specific gravity of 0·9767; optical rotation, — 17·5°; contained 97·16 per cent. of santalol, and was freely soluble in five volumes of 70 per cent. alcohol.

Savin, juniper, turpentine. Mr. Dohme found 80 per cent. of turpentine in one sample.

Sassafras, safrol, coal oil, oil of camphor.

Spearmint, turpentine.

Spruce, turpentine.

Tansy, spruce, turpentine.

Thuja, cedar, pine leaf, turpentine.

Thyme, camphor, turpentine. A recent examination showed that a pure article can be obtained, but generally it runs very low in phenol content.

Verbena, lemongrass.

Vetivert, fixed oils.

Wine, light oil, fusel oil and the distillate obtained from the residue left in the manufacture of ether.

Wormwood, turpentine. Residue from the distillation of oil of tansy. A mixture was once sold as oil of wormwood which cost about 65 cents per pound to make. It consisted of oils of cedar, spruce, amber, tansy refuse, alcohol and turpentine. One of the authors had a sample of this unique compound shown him. Even a hasty examination should have disclosed most of the ingredients.

Wintergreen, true.—There is practically little of this oil to be had. Birch, pure methyl salicylate and mixtures of the two are often sold for it. When it was a common commercial article, Japanese oil of camphor, other light oils, coal oil, sassafras and chloroform were the chief adulterants. There appears to be no satisfactory test to identify an admixture of methyl salicylate and birch except optical rotation, and this observation must be made with extreme care.

Ylang Ylang (Flower of Flowers), kananga, fatty oils, synthetic oil.

In conclusion, the writers would state that they make little claim for originality. This paper contains the results of some years of observation and information supplied by friends. Existing literature was largely drawn upon, chief among which were "Die Aetherische Oele," von E. Gildermeister und Fr. Hoffmann; the English translation of this by Edward Kremers; "The Chemistry of Essential Oils and Artificial Perfumes," by Ernest J. Parry; "Odorographia," by J. Ch. Sawer, and the "Semi-Annual Reports of Schimmel & Co."

DRUG CULTURE.

By F. B. Kilmer.

I have heretofore urged attention to the study of medicinal plants at their source of supply, both in their natural habitat and under cultivation.

In one instance I pleaded for the publication of specific information as to the propagation, growth, collection and preparation of medicinal plants, having in view the highest conservation of their medicinal constituents, and of securing more uniform production,

and especially the issuance, either by the Government or otherwise, of bulletins containing information as to the best modes of cultivating, collecting and preparing such medicinal plants as are suited to the climates of our States and territories.[1]

That these appeals have not passed unheeded is evident from the interest now manifested in the subject of drug culture.

The object of the present communication is to stimulate, and, if possible, add a few practical notes to the somewhat meagre literature on this subject. In the consideration of the cultivation of medicinal plants several points present themselves:

It is stated that the time is not far distant when we will be dependent upon the agriculturist for our medicinal plants; that the destruction of wooded lands and other causes are lessening the supply of drug-yielding plants, and that drug farms will soon be a necessity.

Scientific agriculture has taught the grower how to develop given products of plant life force. If, by scientific cultivation, we can augment or regulate the important active principles of drug plants, there is hope for an economic and scientific recompense.

After a somewhat careful review of the situation it is evident to me that the problem in the cultivation of medicinal plants can best be solved by the American pharmacist.

In this country we can call to our aid resources of a most extensive and varied soil and climate, and scientific agriculture here reaches the highest attainable point. From the beginning we shall have the advantages of American machinery and methods as against peasant labor, which now supplies the bulk of the European products. But of striking importance to pharmacy and medicine is the fact that intelligent drug culture will tend to throw light upon the problem as to the relative value and activity of drugs gathered in a wild state, as compared with those under culture.

Heretofore cultivation has not been necessary or expedient for many drug plants. Our knowledge of the influence of cultivation upon their medicinal and active principles is, therefore, very meagre.

In respect to narcotic drugs, the statement that those which grow wild contain the greater proportion of alkaloids is generally accepted

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[1] "In Lands Where Drugs Grow." AMERICAN JOURNAL OF PHARMACY, April, 1900.

as true, yet I have seen specimens of cultivated belladonna root which would assay over 1 per cent. alkaloids. We are also confronted by the fact that under industrial stimulus cultivation has had the effect of increasing the alkaloidal yield in cinchona, poppy, coca, the caffeine-bearing plants, tobacco, etc.

On one hand the possibility of a scarcity of certain drugs and the probability of the betterment of our vegetable materia medica would seem to be questions of great importance to pharmacy, and would seem to answer the first and most natural query: Will it pay?

The following notes here are given with a view to stimulate further study rather than as having any practical value.

It is quite apparent that the conditions which influence the growth of plants and agricultural products in general will apply more or less to the cultivation of drug plants.

The controlling influences of climate (heat, light and moisture) upon plant growth are well known. To a certain extent climatic conditions are more than soil. The influence of climate upon the medicinal principles of plants is undeniable, but in this respect we have no accurate data upon which to form conclusions.

Numerous alkaloidal drugs at the present time are grown in Great Britain and Western Europe. Here we have cool summers (in England considerable humidity) and a gradual approach of cold weather. Maturity is late and indefinite. Under these conditions we find that certain plants are rich in alkaloids.

These same plants, if transplanted to America, would probably be killed by the fall frosts before maturity, and after a few generations they would acquire the quick-ripening habits which are characteristic of our vegetation. Would the alkaloidal yield follow this change of growth?[1]

Temperature is seemingly not the all-important factor influencing the alkaloidal yield. Some Northern-grown tobaccos are weak in nicotine and others are very rich. Kentucky tobacco is very high in alkaloid. Certain tropical-grown tobaccos are the weakest of all. Poppies have been grown in France yielding many times the amount of morphia of those grown in India. Indications point to humidity and rainfall as more potent than heat.

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[1] Atropa belladonna is quite at home in England, but I have seen thrifty specimens in the tropical gardens of the West Indies as well as in Northern New York.

In my observations upon the European narcotic drugs, the most thrifty specimens, rich in alkaloids, were found among the dense foliage of forests where the rays of the sun never reach the soil, and, as naturally would be expected, these same plants, when cultivated in narrow valleys with a northern or eastern aspect, were the most prolific in growth.

In considering the influence of climate upon drug culture we must also bear in mind that there are vertical as well as horizontal zones of vegetation, and we must therefore expect that the growth of drug plants will follow the well-known range of trees, shrubs, vines, grasses, etc., in this respect.[1]

As to the soil best adapted to the growth of medicinal plants we know almost nothing. It will be necessary to study each plant by itself in this respect. Taking the European-grown drugs as types, it has seemed to me that those regions where the soil was a mixture of humus and calcareous earths were the most productive; soils rich in sand or clay produced the least.

In England aconite and henbane are cultivated in Kent on light sandy soils. They grow wild on marshy land. The soil in Lincolnshire, where drugs are cultivated, contains a good percentage of fine sand and vegetable matter and is not very high in lime.

In another section, where the same drugs are grown, the soil is a brown loam lying over a chalk formation, and contains 15 per cent. of lime. The vegetable matter from this soil is not very high. From the Continent a sample of soil on which lavender and several narcotic herbs are grown was reported to contain 35 per cent. vegetable matter, 51 per cent. of sand (quite fine), 10 per cent. of lime and 2 per cent. of phosphoric acid.

So far as I could learn the potash content in these soils was not high. Observing the conditions under which many medicinal plants thrive, we might conclude that rich soil was not a necessity.

In one of my experiments I selected a very poor red shale soil where grass would not grow, even under fertilization with compost, and on this soil the growth of rhubarb, digitalis, conium, cotton, aconite, etc., was a pronounced success.[2]

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[1] The writer is preparing a list of the common drug plants suited to the temperate zone of the United States with such information as can be gathered as to the zone of vertical cultivation, and will be pleased to receive aid and suggestions.

[2] An analysis of this red shale soil gave the following results:

In botanical gardens the drug plants in the richest beds generally look the least thrifty. It has been stated by experienced drug cultivators that the alkaloidal content of plants is lessened by high fertilization. This statement accords with such actual practices as have come under my notice. Against this statement we have reports of experiments made in the sewage gardens of Berlin and elsewhere which tend to show that fertilization with sewage gives an increase in the alkaloidal yield.

In plants which yield aromatic principles high fertilization is conceded to be beneficial.

I am inclined to the opinion that fresh manure is prejudicial, and that compost, especially that from rotted leaves, straw, etc., is the best. We seem to have no information respecting the use of artificial fertilizers upon drug plants.

It is probably unnecessary to urge the selection of good seeds. It will be found advisable to obtain seeds from plants grown in the same geographical region, or especially in the region representing as nearly as possible the same climatic conditions as our own. My experience has shown that from some cause but a small proportion of the seeds of medicinal plants germinate. (In some of my experiments only 25 per cent. of selected seeds were fertile.)

Every farmer sows from five to twenty times more seed than he needs, and of the seeds which germinate, it is estimated that not more than 10 per cent. give mature plants.

For the present the source of seed supply for medicinal plants not indigenous to our country must be such as can be obtained from wholesale druggists. These will often prove unreliable. The processes of drying, age and other influences to which they have been subjected are not conducive to growth.

It is to be hoped that our seedsmen and botanical gardens will in

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Silicic acid and quartz	73·00
Peroxide of iron	10·00
Alumina	3·20
Lime	4·93
Magnesia	0·90
Potash	0·73
Soda	0·97
Sulphuric acid	trace
Carbonic acid	
Water	1·00

time become reliable sources of supply. For indigenous plants the wild plants themselves will furnish the seed required.

The effects of cultivation upon medicinal plants, while of deep significance, are beyond the scope of this paper. The words of Darwin should be kept in mind: "Changes of any kind in the conditions of life, even extremely slight changes, often suffice to cause variability." Changes of food, climate, changes of any of the conditions of environment, have a modifying effect upon colors, proportions, details of structure, etc.

Under cultivation, the growth of tubers, roots, stalks, leaves, etc., changes. Thus it may be expected that the plant functions from which arise the odorous, alkaloidal or other active principles will also vary between wild and cultivated plants. As to the nature and extent of the effects of cultivation upon the production of these medicinal principles, we have no tangible knowledge. My impression is that in our first attempts we shall do too much cultivation.

The most virile drug plants that we know are for the most part wild. They live a savage life. Their vital force is the accumulation of ages of struggle in the winds and storms of the wilderness; rooted in the black mold rich in the decay of countless preceding generations, a change from barbarism to civilization, from the forest to the conservatory, must cause a marked reaction.

Weeds are always stronger than the cultivated plant. Thus it seems to me that when we bring wild medicinal plants from another country to our own, we had best plant them out in the fields under as nearly as possible the same surroundings as were experienced in their habitat. In other words, let them grow as weeds. It may be that in this way we can utilize some of our fallow lands and waste ground.

Every pharmacist can do his part to help along the cause of drug culture. The Michigan University, with a few acres, and Frederick T. Gordon, with a garden bed, have given us helpful examples.

Every college of pharmacy should have a college farm. Through the aid of this farm and the college laboratory the question of soil, climate and fertilization, as well as other influences upon the plant constituents, can be studied.

In England many country chemists, and on the Continent the rural *Apotheker*, give considerable attention to, and derive a profitable income from, the cultivation and gathering of medicinal plants.

Some of these have achieved quite an enviable reputation for preparations made from plants of their own culture.

Could not American pharmacists in the rural districts take up drug culture, and might it not be a notable feature to be able to advertise: "Rhubard, ipecac and jalap fresh from our own drug farm?"

Pharmacists can invoke the assistance of agricultural experiment stations. Many of these institutions can and will carry out experiments and give reports which from a horticultural standpoint will be of value.

Cultivation of good-sized plots in a variety of locations with records of soil, climate and results, while it may not prove immediately remunerative, will furnish a vast amount of information and interest. Wholesale druggists can materially assist by supplying seeds which are authentic and reliable.

As an easy and instructive experiment for the beginner, I suggest the cultivation of certain alkaloidal plants which are indigenous (stramonium, hydrastis, etc.), with a view of obtaining records of assay of wild and cultivated drugs grown in the same locality.

In a succeeding communication I shall bring together notes of methods followed in the cultivation of certain medicinal plants which have come under my observation.

THE DISCOLORATION OF SYRUP OF IODIDE OF IRON.

By F. W. Haussmann.

The causes of the color change in syrup of ferrous iodide have frequently been investigated, and the published statements resulting from these researches cannot be regarded as conclusive.

Chemical decomposition of the ferrous iodide, indicated by the liberation of iodine, or the formation of ferric compounds, furnish the basis upon which the majority of investigators agree. A consideration of the process of preparation, involving the several steps, especially the common mistake of the tyro to filter the iron solution while yet brown, will readily explain the universal acceptance of such statements.

It has, however, been observed by many pharmacists that the syrup, despite the efforts at preservation by following a number of

contradictory suggestions, such as exposure to direct sunlight on one hand and entire exclusion of light on the other, gradually turns darker.

The fact that application of the starch test gave negative evidence of the presence of free iodine indicated the necessity of another explanation.

This was believed to be found by advancing the theory that a ferric compound is formed, and the statement that ferrous iodide changed to ferric iodide or oxyiodide was accepted as conclusive.

This change probably takes place if an aqueous solution of ferrous iodide is evaporated with the view of obtaining the salt, but, based upon results obtained from the examination of a number of specimens of various age and shade of color, the writer questions if this takes place in the syrup.

In an examination of some fifteen discolored samples not one reacted for the presence of ferric compounds.

This result practically excludes this theory, and the cause of discoloration must be sought elsewhere.

Recently the action of free acids upon syrups has received attention, and the changes produced thereby have been described. Considerable work still remains to be done in this direction, and the action of metallic salts, in particular those of an acid reaction, upon saccharine solutions demands exhaustive investigation.

Regarding the reaction of ferrous iodide, the statements of the Pharmacopœia are contradictory, the saccharated iodide being stated to have a slightly acid and the syrup a neutral reaction. Founded on the results of an investigation carried on for some time, the writer inclines to the belief that the action of the iron salt, without itself undergoing any chemical change, causes discoloration of the syrup.

The amount of heat employed in preparing the syrup also has an important influence.

The following reasons may serve to substantiate these assertions:

Ferrous iodide is not the only iron salt which, with the influence of heat, causes darkening in syrup.

A syrup of ferrous sulphate, containing 10 per cent. of the salt, prepared by dissolving sugar in an aqueous solution and heating to boiling, on standing from 4 to 6 months with exposure to light, turned from a light green to a brown color.

Examination at the expiration of six months, with the view of

determining the possible formation of a ferric compound, gave a negative result.

Identical results were obtained with a syrup containing 10 per cent. of ferrous chloride.

The influence of temperature is demonstrated by the fact that syrups prepared by dissolving the sugar in the iron solution at a temperature below the boiling point, possess greater stability than those heated to boiling.

The addition of hypophosphorous or other acids exerts no influence except to prevent the liberation of iodine.

Several specimens of the syrup to which hypophosphorous acid was added, originally of a bright green color, have gradually turned brown.

The premature addition of an acid may cause the syrup to rapidly change in color.

In an instance, where this possibility was considered, the addition of hypophosphorous acid to a boiling bright green syrup was followed by an immediate change to dark brown.

This points to the necessity of adding the acid only to the perfectly cold syrup.

This color change may also be noticed if a small quantity of the syrup, either with or without an addition of acid, be heated to boiling and the heat continued. Caramelization will be the consequence.

Brief mention may be made of the restoration of discolored syrups of iodide of iron.

Specimens containing free iodine may be restored by the well-known practice of digestion with iron filings.

Care in the regulation of heat must be observed, and addition of a sufficient amount of water to restore the original weight of the syrup should not be neglected.

A syrup, in which the brown color is due to caramelization, is difficult of restoration.

Animal charcoal will remove some of the brown color, but the writer has never been able to completely restore the original bright green color by this method.

It may incidentally be mentioned, that if further investigations should prove this action of iron salts upon saccharine solutions to be true, the color change in elixirs containing scaled iron salts, which is the source of much annoyance to the pharmacist, is thereby explained.

PHARMACISTS' APPARATUS STAND.

By J. Percy Remington, B.S.

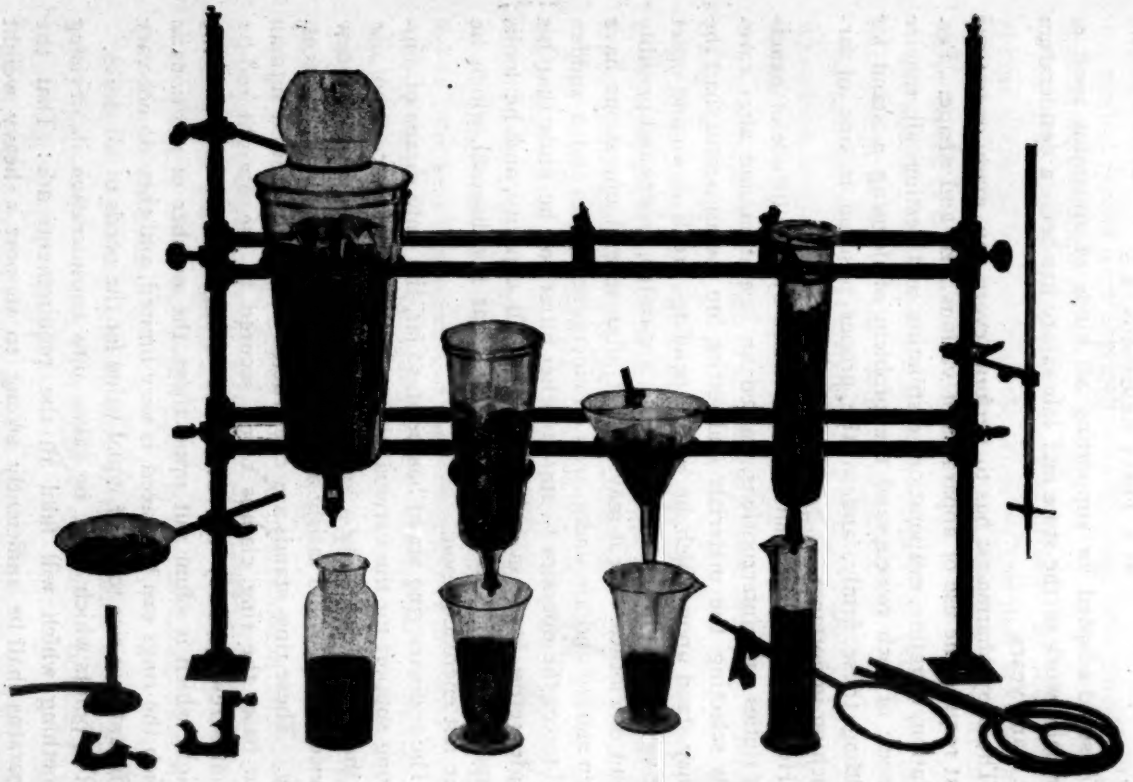
A stand adapted for supporting all kinds of apparatus used in the daily work of the store and laboratory has been a desideratum for many years.

The busy pharmacist has to perform every day many operations that require the use of apparatus of various size and shape. Percolation, filtration, evaporation, distillation and testing all require the use of such vessels, and the problem of devising a stand for holding these firmly, and in the proper position, is one of far-reaching importance.

How often has the pharmacist, harassed by a multitude of exacting duties and interruptions, started an operation, and after carefully selecting the materials and setting up the apparatus, had the flimsy stand upon which he was depending break down and upset the vessel, thus losing time, patience, apparatus, results and possibly a suit of clothes. Or it may be that after several operations have been started and are under way an emergency arises and a sudden call forces the operator to start another filtration; he finds that his single retort stand is crowded to its full capacity, and he looks despairingly at the limited counter space at his disposal, which he dare not encroach upon.

The ordinary ring stand has been, so far, the only means of supplying support for the various pieces of apparatus in constant use by the pharmacist. For a long time it has been evident that a new device, which would satisfy all the various needs, is an actual necessity. These ring stands are constructed of a rod screwed into an iron base, the ring clamps being secured to the upright rod by thumbscrews. They are not made strong enough to stand the weight which is often put upon them, the number of positions in which the rings can be placed is very limited, and they do not vary sufficiently in size to be of equal value for the needs of all stores.

The points which must be taken into consideration in devising something which will fulfil all the requirements are: That the apparatus shall be sufficiently strong to support a heavy weight likely to be put upon it; that it may be so adjustable that the rings may be put in any position necessary; that it may be compact enough to occupy very little space (and this to be the least valu-



PHARMACISTS' APPARATUS STAND.

able); that it may be so constructed that it may be made of any dimensions to fit the space available; and that it may be enlarged or diminished in size, to suit the needs of the business.

The stand which is here described is the result of an effort to supply all these requirements. It is constructed of two upright tubes of heavy iron, secured firmly at the bottom by counter plates. Two parallel, horizontal, double tubes are arranged so as to slide up and down these upright tubes, and made secure by means of thumbscrews at each end. This completes the framework of the stand. The ring clamps, instead of being all in one piece, as in the ordinary stands, are made in two parts, the clamp composing one part, and the rings, with 12-inch shanks, the other part. The shanks of the rings are passed through two openings in the clamps, and are made secure by thumbscrews. The clamps are of two kinds, those which slide horizontally on the double tubes, and those which slide vertically on the upright tubes. The shafts of the rings are all of the same size, so that they can be used with either form of clamp, the rings varying in diameter from 3 inches to 7 inches.

All the thumbscrews are of brass, so as to prevent the possibility of rusting, and the castings are of malleable iron, so that the chance of breakage is very slight. The framework, being all composed of heavy iron tubing, is sufficiently strong and firm to uphold any weight which would be likely to be put upon it, and every part is constructed with a view to withstand hard usage.

It will be readily seen that the adjustability of this apparatus stand is complete. It is possible to get any desired position of the rings in the three dimensions of space, upward or downward, right or left, backward or forward.

The space which it occupies when not in use and the rings removed is very small. The frame stands on the counter 4 inches from the wall, thus taking up the room which is least valuable, and leaving all the front part of the counter available for other purposes. As the amount of space varies considerably in different stores, the advantage which this stand possesses in being made of iron tubing which can be cut in any length to suit the space available, and the fact that it can be screwed to the counter or to the wall, or suspended from a shelf or the ceiling, will commend it to the practical and busy pharmacist.

THE ASSAY OF BELLADONNA ROOT AND ITS SOLID EXTRACT.

By Arthur Wayne Clark, B.S.

Having occasion constantly to handle samples of large quantities of the root of Atropa Belladonna used in preparing solid extract for use in belladonna plasters, the writer has had some experience with about all the standard methods of assay, and while little that is new is herein described, yet the method of procedure is given in detail, believing this attention to minutia to be a necessity to success and lack of such information the chief difficulty in working out a rational method for one's own constant use.

In favor of the method here described, it can be said that it is quite accurate, and yet can be carried out with a relatively short amount of time actually given to the work.

The method of extraction used is hot extraction with a reflux condenser, and while this and the other parts of the process require about twelve consecutive hours for the completion of one assay, still the total time given to the work need not exceed three or four hours, and during the shaking-out process the work can be left for any length of time necessary; in fact the longer the better. Besides this, duplicate assays can readily be managed at the same time, thus effecting a considerable saving of labor.

The objection is sometimes made to hot extraction of belladonna root, that there is a possibility of loss of alkaloid from the heat applied, but the writer could never see the force of this argument, for practically all the methods ever proposed finish by evaporating down the alkaloidal solution in chloroform or ether, thus applying the very heating process objected to above.

The fact that the mixed menstruum boils at 65° C. would seem also to make it impossible that there should be any loss from this source.

The advantages of hot reflux extraction are that it can be carried out much more quickly than a cold percolation, is more economical of menstruum, an important factor where a large number of assays is constantly being performed for commercial purposes, and it requires no attention whatever after the heat is once regulated, provided, of course, there is sufficient water-bath capacity to run for the required time.

More important than all these considerations is the fact that, on account of the concentrated character of the menstruum used, there is very little inert resinous matter carried through, and consequently the shaking-out part of the assay is free from this serious complication, always present in assaying an ordinary extract. Presumably, because of this feature, emulsification of the alkaline solution is quite infrequent instead of being the rule, as in assaying an extract.

METHOD OF PROCEDURE.

Weigh out in a tared beaker about 20 grammes of the root ground moderately fine. It is not necessary to weigh closer than the third decimal place in grammes, as an error of ·001 gramme here is not appreciable in the percentage result. Pour the weighed contents of the beaker carefully into a clean, smooth porcelain dish, of 18 or 20 centimetres diameter, tapping the beaker to shake out as much of the root as possible.

The menstruum used is that advised by Dunstan and Ranson, and is manipulated as follows: Mix up 60 c.c. or 70 c.c. of equal parts by volume of absolute alcohol and chloroform, and take about one-quarter of the mixture to moisten the root in the porcelain dish. Pour this portion of the alcohol-chloroform mixture first, into the tared beaker, whirling it around to collect the fine particles of root which adhered to the glass, then pour it into the dish and mix up well with a clean spatula until the root is evenly moistened.

Now take the inside glass cup of the reflux extractor, which should be about 1 inch in diameter and 3 inches deep, put in the bottom an absorbent cotton plug moistened with the alcohol-chloroform mixture and, holding the cup over the dish so as to catch in the latter any that falls, carefully transfer with a spatula a little root at a time into the cup, packing it in gently with a large, smoothly-rounded glass rod, finally shaking off any particles of root adhering to the rod and spatula.

Prepare a small wad of absorbent cotton for the top of the packed root, moisten it with some of the mixture and use one side of it as a mop to take up the last particles of the moistened root from the porcelain dish, spatula and rod.

Now place this cotton on top of the root packed in the glass cup, putting the side downwards that was used as a mop.

On top of the whole place sufficient clean lead shot to cover it and to hold it down.

Now set up the reflux condenser, add the rest of the 60 c.c. or 70 c.c. alcohol-chloroform and heat on a water-bath, extracting for seven hours. Presuming the rate of percolation to be 60 or 70 drops per minute, there will pass through the 20 grammes root about 1,500 c.c. of the hot menstruum or about seventy-five times its weight, a much larger proportion than is ever used in a slow cold extraction.

The above-described method of moistening and packing (the granulated root) is sufficiently accurate if reasonable care is exercised in carrying it out.

The percolate containing the alkaloid is now transferred to a separatory funnel and the alkaloid dissolved out by shaking with 20 c.c. dilute H_2SO_4 (½ per cent.).

Sometimes the fluids seem to mix and there is no separation or line of demarcation. If this is the case, add 10 c.c. or 15 c.c. water, shake again and the chloroform layer will be precipitated on standing about a minute, leaving eventually a clean-cut line between the liquids.

Since the chloroform solution separates as a bottom stratum, it must be drawn off first into a clean beaker, after which the acid solution is run out, well drained and put aside and the chloroform solution returned to the separator.

The chloroform solution is then shaken again with 15 c.c. dilute acid, separated in the same way and shaken again with 10 c.c. of the dilute acid. Quite frequently it will be found that the third shaking out will cause emulsification of the two liquids. If this happens it can be instantly remedied by adding 10 c.c. or 15 c.c. more of the original mixture of alcohol and chloroform in equal volumes and shaking up again after adding it.

There is no use in carefully washing out the stem of the funnel, etc., between each of these operations, as the minute quantity of solution adhering to it is simply carried over and is again separated in a much diluted condition next time.

There is usually a small quantity of flocculent precipitate and dirt collected at the line of separation in these acid extractions, and wherever such occurs to any appreciable extent, the dirt should be run out with the chloroform stratum, bringing the clean edge of the acid layer down to the bottom of the opening in the stop-cock. Sometimes a minute amount of the acid solution has to be allowed to go through with the dirt, but this again will be diluted and

reseparated next time, so that the loss will not be appreciated if the operation is carried out with care.

If in the third separation there is so much dirt present that there is danger of a very incomplete separation, then it is well to make a fourth extraction, using 10 c.c. acid again, but three extractions are usually amply sufficient.

This procedure leaves the acid solutions clear of insoluble matter, and thereby the alkaline extraction next carried out will be uncomplicated by its presence.

The three mixed acid solutions are now put into a clean separator, 20 c.c. 10 per cent. ammonia and 20 c.c. chloroform added, the whole violently shaken for several minutes and then allowed to stand.

The chloroform layer should fall down in five or ten minutes, leaving a clean-cut line between the two strata. The chloroform solution is then drawn off and set aside and the extraction repeated with 15 c.c. and again with 10 c.c. chloroform. Twirling and rocking the separator will greatly assist the rapid separation of the two liquids and sometimes the separation takes place almost instantly.

Sometimes an emulsion is formed and great difficulty is experienced in causing a separation, in which case an easy remedy is at hand in the very valuable suggestion of Moerk (Am. Jour. Phar., March, 1899), to put a few small flakes of stearic acid in the separator and shake up violently again. It is remarkable to witness the immediate separation of the two fluids, and as Moerk has proved that the stearic acid does not influence the result, this method has been used many times with great satisfaction, more especially, however, in extract assays, as it is seldom needed in direct root assays made as above.

In these alkaline extractions any sediment that collects at the line of separation should not be drawn off, but must be left in the upper aqueous stratum, and, after the third extraction, washed by adding a small amount of chloroform and running it out without shaking, but leaving the dirt behind, the chloroform being added to the rest. Care must be taken to draw off only the clear solution. This also rinses out the stem and should not be omitted.

The chloroform solutions are now all filtered through absorbent cotton into an Ehrlenmeyer flask of about 300 c.c. capacity and evaporated on a water-bath to a brown varnish-like residue, finally

blowing air into the flask to remove all chloroform and to carry out any free ammonia which may be present. Now add about 10 c.c. chloroform, shake up and evaporate down again as before, to assist in driving off any ammonia. This residue is then titrated as directed later on. Ether should not be substituted here for chloroform, as the writer has found ether to be almost invariably acid, which being the case, it will ruin the result.

The water-bath should be heated by steam, as any open flame nearby will decompose the chloroform vapors to hydrochloric acid, filling the room with its fumes and possibly neutralizing some of the alkaloid in the flask. The operation can, however, be carried out over a bath heated by a flame, if there is a good ventilation to remove the vapors, and the contents of the flask are kept boiling hard.

In the shaking-out process the writer experienced considerable trouble with the spitting of the solutions from the mouth of the separator when the stopper was removed after shaking. The U.S.P. advises that the best way to control this in these separators is to shake the contents slightly before putting in the stopper, but this scheme was not at all successful in preventing the trouble, due probably to the warmth of the hand in shaking the very volatile contents of the separator. An easy solution of the difficulty, however, was found in putting the stopper in tightly, shaking up as usual and allowing to separate without relieving the pressure, and then, when ready to draw off, opening the outlet cock slightly and allowing the pressure to exert itself in gently blowing out the lower stratum through its natural outlet. After a few cubic centimetres have been expelled the pressure will have expended itself, the cock can be closed and the stopper removed without harm, after which the solution can be run off as usual.

As to the method of titrating the alkaloidal residue from the three mixed chloroform solutions, the writer finds that the best way is to dissolve the brown residue in about 5 c.c. neutral alcohol in the cold, then add about 100 c.c. distilled water and three drops of 1 per cent. alcoholic hæmatoxylin solution. This is then titrated at once with twentieth normal hydrochloric acid $\left(\frac{N}{20}\ HCl\right)$ to a pure yellow color, the neutral point being indicated by the *absence of any trace* of red.

With a little practice on alkaline solutions this point can usually be read to a drop, but it is well to note the neutral point and then run over it and titrate back with $\frac{N}{20}$ alkali to the first indication of any tint, thus confirming the former reading. The number of cubic centimetres acid used multiplied by ·0145, the $\frac{N}{20}$ factor for atropine, gives the weight of alkaloid present in the 20 grammes root.

It seems to have been the practice among some chemists to dissolve the alkaloidal residue in a measured excess of the standard acid and titrate back with alkali, but solution in alcohol is very much easier and quicker and also gives more accurate results, for the writer has found that the acid dissolves the thick gummy residue very slowly and leaves a quantity of flocculent insoluble matter floating in the solution, rendering a close color-observation practically impossible. By dissolving in alcohol this does not take place until an excess of the acid has been added and by that time the operation is finished.

The accuracy of this method compared to the direct acid solution was tested by taking a chloroform solution from an assay and dividing it in half, each half being evaporated down in a separate flask, one dissolved in $\frac{N}{20}$ HCl and the other in alcohol. The results were exactly alike, except that the correct neutral point was much more easily seen in the alcohol solution. The presence of the small amount of alcohol, therefore, has no influence on the result and its use is very beneficial both in regard to time and accuracy.

For some reason which has not been ascertained, the alkaloidal solution colored with hæmatoxylin will sometimes turn a greenish or purplish color as the acid is added to it, but this apparently does not influence the result, as the point of disappearance of the color is as clearly defined as though the color were a clean red, the final yellow being the same as usual.

ASSAY OF THE SOLID EXTRACT.

The best method of procedure in assaying the solid extract has proved to be as follows:

Weigh out in a tared beaker 4 or 5 grammes extract and with a glass rod rub it up smooth with 10 c.c. or 15 c.c. ½ per cent. H_2SO_4,

pouring the mixture into a separator. Rinse out the beaker several times in the same way with smaller quantities of the dilute acid, transferring each portion to the separator. Now wash the acid mixture in the separator by shaking with 20 c.c. and again with 15 c.c. chloroform, running the chloroform out as waste. Take care to draw off only the clear solution. Next rinse this waste chloroform by shaking very gently in another separator with 10 c.c. dilute sulphuric acid, throwing away the chloroform and returning the acid to the rest of the acid washings in the first separator.

Neutralize the acid solution in the separator by adding 20 c.c. 10 per cent. ammonia and extract the alkaloid by shaking with 20 c.c., 15 c.c. and 10 c.c. chloroform exactly as in the root assay. There will be a very considerable quantity of brown flocculent material collected at the line of separation, floating in the chloroform and extending down through it so that sometimes only very little clear chloroform solution can be drawn off at first. As nothing must be removed but this clear solution, it will often require as much as an hour to complete each separation, although it can be done more quickly with some samples. The use of stearic acid is usually necessary in these separations, for in many cases emulsification is so complete that the liquids would never separate without its aid.

When separation begins the only way to work is to draw off the first clear part, bringing the floating material down to the top of the hole in the stop-cock; then by rocking, twirling and tapping, followed by several minutes' standing, the floating material will draw up or float to the top of the chloroform, packing together or solidifying so to speak, and leaving some more of the clear chloroform to be drawn off as before.

The same procedure is repeated generally five or six times with each separation until the bulk of the flocculent sediment is reduced in size as much as possible, after which the next portion of chloroform is added to the separator, shaken up and separated little by little in the same way.

After the third separation is done add about 10 c.c. chloroform and draw it off without shaking, adding it to the rest as before, this being done to dilute the small amount of alkaloid solution remaining in the separator, so that the loss will be inappreciable.

Shaking out the extract in this way consumes considerably more time than is the case with the assay of the root direct, due to the

presence of resinous matter and other inert materials. It can, however, be accomplished with extreme accuracy if the operator will work patiently with the alkaline extractions as directed.

These chloroform solutions of the alkaloid are now mixed, evaporated down and titrated exactly as described above in the assay of the root.

J. Ellwood Lee Company Laboratory.

NOTE ON BENZOINATED LARD.

By Melvin W. Bamford.

Having recently had considerable trouble with benzoinated lard made from commercial lard because of the impurities in it, the writer visited a pork-packing establishment in order to obtain some information on the subject, and while there secured a quantity of what is known to the trade as "Pure Leaf Lard," which really is the leaf fat as it is obtained from the hog.

From this fat there was made a quantity of lard by the process recommended by Professor Redwood, and adopted by the British Pharmacopœia. After removing as much of the membrane and tissue as possible, the fat is simply heated at a temperature not exceeding 150° F., and as the lard separates from the membrane, it is strained through flannel into another vessel. It will be noticed that there is no water used in the process, the advantage being that the lard thus made contains absolutely no water.

This lard was then benzoinated by the United States Pharmacopœial process, and the resultant product was found to be perfectly sweet and smooth, and to have an agreeable odor of vanilla.

The actual cost of the preparation, making an allowance of 10 per cent. for waste and 20 per cent. for labor, is about 12½ cents a pound. There are several makes of benzoinated lard on the market which are fully as good as this product; but the cost of these is from 20 to 25 cents a pound, so that the saving should be sufficient inducement to the pharmacist to make it himself. In addition to this, he will have the satisfaction of knowing that he has an absolutely pure preparation.

NOTE ON WARBURG'S TINCTURE.[1]

By Ferdinand A. Sieker.

The first and second editions of the National Formulary state that "each fluid ounce contains 10 grains of quinine sulfate."

The first edition of the National Formulary directs 1,280 grains of quinine sulfate in 8 pints of tincture, which is equivalent to 10 grains of quinine sulfate in each fluid ounce.

The second edition of this work directs 100 grammes (1,543·2 grains) of quinine sulfate in 5,000 c.c. (169·07 fluid ounces), which is equivalent to 9·131 grains of quinine sulfate in 1 fluid ounce, and not 10 grains as is intended.

The original formula for Warburg's tincture directed 10 ounces (Troy) of "quinia" for the amount of tincture resulting from 500 fluid ounces of proof spirit. If the yield is regarded as 480 fluid ounces, then 1 fluid ounce contains 10 grains of "quinia." Therefore, 10 grains in 1 fluid ounce may be regarded as correct.

The amount of quinine sulfate in my formula (Amer. Jour. Pharm., Vol. 72, p. 573) is based on the quantity directed by the second edition of the National Formulary, which is not quite correct. My formula should therefore be corrected as follows:

Use 219 grammes of quinine sulfate instead of 200 grammes, and 24 grammes of sulfuric acid instead of 22 grammes.

The formula for the modified tincture (Amer. Jour. Pharm., Vol. 72, p. 575) should therefore read: Use 73 grammes of each, cinchonine sulfate, cinchonidine sulfate and chinoidine pure, instead of 66·66 grammes.

The quantities of fibrous vegetable drugs, etc., given in my formula are also somewhat larger than directed by the National Formulary. The quantities are computed according to the original formula published in England, where in compounding the Troy ounce is used for solids and the fluid ounce for liquids.

Laboratory of Lehn & Fink, New York.

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[1] Refer to Amer. Jour. Pharm., 1900, Vol. 72, pp. 571 to 575.

FORMULA FOR ELIXIR OF HEROIN AND TERPIN HYDRATE.[1]

By T. B. McClintock.

Heroin	5½ gr.
Terpin hydrate	3 dr., 12 gr.
Spirit of bitter almond (5 per cent.)	10 m.
Compound spirit of orange	15 m.
Syrup of wild cherry	2 fl. oz.
Glycerin	11 fl. oz.
Alcohol, q. s.	1 O.

Powder the terpin hydrate and dissolve it in the glycerin by the careful application of heat. Dissolve the heroin in 2 fluid ounces of the alcohol, adding to the solution the spirit of bitter almond and the compound spirit of orange. When the solution of terpin hydrate has cooled, mix the two solutions and then add the syrup of wild cherry and sufficient alcohol to make 1 pint of the finished elixir.

RECENT LITERATURE RELATING TO PHARMACY.

MAGNALIUM.

This is a silver white alloy composed of aluminum and magnesium. It is not affected by air and water, and even withstands the oxygen acids to a great extent, but is attacked by alkalies. The specific gravity ranges from 2 to 2·2 at 15° C. It can be rolled into sheets and drawn into wire. The reflective power is very high, and it does not absorb the ultra-violet. These properties, together with its low density and high rigidity, make it a very superior material for specula.—*Brit. Jour. Phot.*, 1900, 47, 2090.

L. F. Kebler.

MANGANESE DIOXIDE IN BRAZIL.

The recently opened up mining district near Iterbira, Brazil, is producing a large quantity of very pure black oxide of manganese. This ore is apparently the remains of a manganiferous limestone from which the limestone has been removed. It is a hard metallic-looking ore, interstratified with about 20 per cent. of the hydrated manganese, which seems to contain the greater amount of the im-

[1] The above formula was received from the author and was recommended as having proven quite satisfactory in the hands of some of the physicians of his acquaintance.—Ed.

purities. The dried (100° C.) material from a cargo will assay from 50 to 55 per cent. of metallic manganese. The moisture varies from 10 to 20 per cent. The quality seems to be the same deeper down in the mine. It is estimated that the amount of ore in sight on one property is 2,000,000 tons. The ore outcrops on hills; can be mined without motive power, and run directly into railway bins, without picking, by means of shoots.—H. K. Scott, Iron and Steel Inst., spring meeting, 1900. L. F. K.

CHEMICAL COMPOSITION OF SALA AMALGAM.

The oldest known natural silver amalgam is found at Sala, Sweden. Two distinct varieties have been analyzed, corresponding to the formula Ag_2Hg_3 and Ag_5Hg_6. The gold amalgams of Columbia and California correspond to the formula Au_2Hg_3. —H. Sjögren, from *Chem. Ztg. Rep.*, 1900, **24**, 151. L. F. K.

THE PROTEOLYTIC ENZYME OF GERMINATED BARLEY.

Whether germinated barley contains a proteolytic enzyme or not is a much mooted question. Eminent investigators have arrived at different results. The workers below, being dissatisfied with the present state of affairs, determined to remove the darkness if possible. A 10 per cent. solution of gelatine was treated with the substance under examination. The material was rendered antiseptic by means of thymol and the mixture kept in an incubator at 20° to 40° C. The gelatine solution was cooled from time to time to 5° C. and examined for the first appearance of liquefaction at this temperature. It was found that an enzyme capable of liquefying gelatine is certainly present in malt. The enzyme may be extracted by very dilute acetic acid or digestion with water at any temperature below 32° C. It is almost, if not quite, destroyed by mashing at 70° C.

The presence of acetic acid favors its growth, but liquefaction of gelatine is much more rapid if the extract is slightly alkaline. The enzyme appears to be of a trypsin nature. Only traces of the enzyme occur in the ungerminated barley, but the increase is marked when germination begins and continues until the seedling becomes green.—W. Windisch and B. Schellhorn, *Woch. für Brau.*, 1900, **23**, 334. L. F. K.

THE PRODUCTION OF CRYSTALS OF MERCURIC AND MERCUROUS IODIDE IN THE WET WAY.

By adding ethyl or methyl iodide (preferably the latter) to an aqueous solution of mercuric acetate or mercurous nitrate, then shaking and allowing the mixture to stand in the cold, there are slowly formed crystals of mercuric or mercurous iodide. The former are bright red transparent plates and the latter are bright yellow needles.—F. Bodroux, *Comp. rend.*, **130**, 1622.

L. F. K.

CERIC SULPHATES.

Two ceric sulphates exist, the one yellow in color and the other red. The former is of simple constitution, the latter of a complicated structure. By dissolving cerium hydroxide in concentrated sulphuric acid and evaporating the solution, then recrystallizing from water, the yellow sulphate is always obtained in the first crystals and the reddish-brown sulphate then generally comes down afterwards as large crystals. Careful analysis shows the yellow sulphate to have the formula $Ce(SO_4)_2.4H_2O$ and that the red salt is $Ce_2(SO_4)_3.2Ce(SO_4)_2.2H_2O$.

In the red salt the metal exists in both the trivalent and tetravalent forms in equal amounts. The yellow compound dissolves to a clear yellow solution in water, but the red salt is at once decomposed by water into insoluble basic compounds.—W. Muthmann and L. Stützel, *Ber. d. Chem. Gesel.*, **33**, 1763. L. F. K.

LITHIUM PEROXIDE.

On mixing hydrogen peroxide (what strength ?) with a 5 or 6 per cent. solution of lithium hydroxide, then adding an equal volume of absolute alcohol and allowing the whole to stand, beautiful colorless crystals are deposited, having the following formula: $Li_2O_2.H_2O_2.3H_2O$. When placed into a vacuum with phosphorus pentoxide, these crystals gradually lose water and leave practically nothing but anhydrous lithium peroxide, Li_2O_2.—de Forcrand, *Comp. rend.*, **130**, 1465. L. F. K.

TO PREVENT THE INTOXICATING EFFECT OF ALCOHOL.

L. Meyer, Eng. Pat. No. 6453, Apr. 6, 1900.

This patent covers a preparation consisting of burnt powdered coffee bean and olive oil (neither of which is new), to be taken

either directly or in the form of capsules, pills (?), lozenges (?), etc. L. F. K.

GLYCERO-SODIUM BORATE.

This compound of the Russian Pharmacopœia has been shown to be a mixture of the tri- and tetra-glycero-sodium borate and not a true chemical compound. A less hygroscopic preparation can be produced as follows: Mix 120 grammes glycerin (sp. gr. 1·255) with 100 grammes of borax and heat until the glassy mass becomes thready. It is then partially cooled and rolled into sticks. This compound is tetra-glycero-sodium borate of the formula $(C_3H_5)_4(H_2BO_3)_2(HNaBO_3)_2(OH)_6O$, is readily soluble in alcohol and water and melts at 153° to 154° C.—E. Schazki, *Chem. Ztg. Rep.*, 1900, **24**, 148. L. F. K.

CRYSTALLIZATION OF AMORPHOUS SUGAR.

The presence of crystals, acting as nuclei, is conducive to the crystallization of amorphous sugar. Alkali salts, which to a certain extent prevent the formation of invert sugar, induce crystallization, while the other organic salts do not exert this influence. Light assists crystallization, but invert sugar retards it, and the retardation is proportional to the amount of invert sugar present.—F. G. Wiechmann, *Bull. l'Assoc. des Chim. de Sucr. et de Dist.*, 1900, **17**, 745. L. F. K.

THE PREPARATION OF ETHYL AND METHYL ALCOHOLS FROM THE CORRESPONDING HYDROCARBONS.

A German patent has been taken out for the production of the above alcohols by the direct union of the corresponding hydrocarbons and oxygen. These gases are mixed with a quantity of oxygen or air insufficient for complete combustion and the mixture passed through a tube containing a red-hot catalytic mass. If platinum is employed as the catalytic agent, oxidation proceeds too far, and the result is fatty acids only. The less energetic catalytic agents, such as asbestos, pumice stone, the various forms of copper or certain mixtures of the above, are the most suitable.—From *J. Soc. Chem. Ind.*, **19**, 684. L. F. K.

EDITORIAL.[1]

THE SPECIALIST AND THE PHARMACOPŒIA.

In the *Pharmaceutical Journal* for May, 1900, p. 523, Mr. E. M. Holmes comments upon and takes exception to some of the statements in an editorial note on "Vegetable Drugs in the U.S.P.," which appeared in the AMERICAN JOURNAL OF PHARMACY, May, 1900, p. 236, and which was reprinted in the *Pharm. Jour.*, June 23, 1900, p. 669.

It may be well to state at the outset that the editor lays no claim to being considered a specialist, or an authority or critic on botanical nomenclature, or the subject of the origin of foreign drugs; and any statements which he may have made must, of necessity, have been based upon the authority of some one else.

In a previous editorial note (AMER. JOUR. PHARM., 1900, p. 138) the writer sanctioned the view of an American botanist[2] (*Proc. A. Ph. A.*, 1898, p. 242) that Engler and Prantl's "Pflanzenfamilien" should replace Bentham and Hooker's "Genera Plantarum" as our authority. It so happens that the statements to which Mr. Holmes takes exceptions are for the most part those which have received the sanction of the aforesaid authority, viz., Engler and Prantl, and which have been prepared by the numerous experts in systematic botany who have contributed to this monumental work. I present herewith the language used by these experts in their descriptions of certain of the drugs considered by me, as also the exact references, and a careful comparison with the editorial note referred to will show the origin of the information therein presented. The exact references were not given previously, as it was considered sufficient to merely mention the names of the experts who had contributed this information.

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[1] The substance of this editorial has already appeared in the *Pharm. Jour.*, July 21, 1900, p. 58, in a signed article. Since that time Mr. Holmes has written another article in reply for *Pharm. Jour.*, 1900, p. 443.

[2] After carefully comparing the merits of Bentham and Hooker's "Genera Plantarum" with Engler and Prantl's "Die naturlichen Pflanzenfamilien," the author says: "In view of the considerations above set forth, the writer has no hesitation in urging upon the Pharmacopœia Committee that they sustain their progressive record by adopting the authority of the modern work" [viz.: the work of Engler and Prantl.—H. K.].

MYRRH.

In the consideration of myrrh, H. Engler (in E. and P., III. Theil, 4. Abth., Bog. 16–18, p. 255) says:

"C. abyssinica (Berg), Engl., liefert wie durch Deflers und Professor Schweinfurth festgestellt ist, die echte Myrrhe, Myrrha oder Gummi Myrrhæ. *C. Schimperi* (Berg), Engl., enthält reichlich Balsam und würde gute Myrrhe liefern können; es ist auch nicht unwahrscheinlich, dass ein Teil der arabischen Myrrhe von dieser Art abstammt."

COPAIBA.

P. Taubert, in the consideration of the genus Copaiba in E. P., III. Theil, 3. Abth., Bog. 8–10, p. 131, says: "Die Mehrzahl der amerikanischen Arten liefern den als Copaiba, Balsam bekannten Harzsaft: besonders geschätzt ist derjenige von *C. officinalis*, Jacq.; ebenso wertwollen Balsam liefern *C. guyanensis* (Desf.), O. Ktze., und *C. multijuga* (Hayne), O. Ktze., *C. confertiflora* (Benth.), O. Ktze., *C. coriacea* (Mart.), O. Ktze., *C. Langsdorffii* (Desf.), O. Ktze., und *C. oblongifolia*, Mart. (O. Ktze.)."

TAMARIND.

After describing *T. indica*, L., as yielding Pulpa Tamarindi conda, P. Taubert says (in *Ibid.*, p. 140): "Auch aus Westindien und Ecuador wird Tamarindenmuss, als amerikanische Tamarinden, bezeichnet, ausgeführt und in England bevorzugt. Dasselbe stammt von *T. indica*, L., *var occidentalis*, Gärtn."

BALSAM OF TOLU.

The same author (*Ibid.*, p. 191) says: "Auch *T. peruifera* (L. fil.), Baill., in der nordöstlichen Hälfte Südamerikas heimisch, liefert geringe Mengen eines festen aromatischen, den Tolubalsam ähnlichen Harzes."

SUMBUL.

The correction made by Mr. Holmes in his comment on this drug is apparently warranted, as there seems no question but that Indian sumbul is yielded by *Ferula sumbul* (Kffm.), Hook. fil., the roots of which are said to resemble those of *F. Narthex*, Boiss., the Bombay sumbul being the product of *Dorema Ammoniacum*. (See E. P., III. Theil, 8. Abth., Bog. 13–17, p. 232; and Pharmacographia, p. 312.)

AMMONIAC.

In the consideration of Ammoniac, O. Drude (in E. and P., III. Theil, 8. Abth., Bog. 13–17, p. 233) says: "Seit dem Jahre 1825 weiss man das seit Dioscorides also Ammoniacum bekannte Gummiharz der Gatt. Dorema entstammt, und zwar haupsächlich der einen, mit grosser Verbreitung von Persien bis tief in die Balchasch-Alakulwüste begabten Art, von welcher verschiedene Varietäten existieren; diese ist *Dorema Ammoniacum*, D. Don. Gleichfalls liefern Ammoniak gummi *D. aucheri*, Boiss., und *D. aureum*, Stcks."

STORAX.

F. Niedenzu, in the consideration of the genus Liquidambar (E. and P., III. Teil, 2. Abth., a., Bog. 7–9, p. 124), says: "Alle Artenfer Liquidambar (und Altnigia) liefern Storax. Am meisten geschätzt ist der von *L. orientalis* stammende, officinelle 'Storax liquidus.' Im amerikanischen, dort gleichfalls officinellen Storax wies Miller Storacin, zimmtsaurephenylpropylester und storesin nach; als "(Southern) sweet gum" ist das Balsamharz von *L. styraciflua* ein beliebtes Kaumiltel in Centralamerika und den südatlantischen Unionsstaaten."

IPECACUANHA.

In the editorial note upon Ipecacuanha no attempt was made to consider the nomenclature of the subject, as this had already been done by another writer (see *Proc. A. Ph. A.*, 1898, p. 243). It is apparent that in citing the present U.S.P. name a typographical error occurred. The authority for *Cephaelis Ipecacuanha* is (Brotero) A. Richard. The other point that Mr. Holmes takes exception to is a matter of opinion. But the results of experiments which will throw more light upon this subject, we have reason to believe, will be forthcoming during the next year.

SARSAPARILLA.

In the consideration of the genus Smilax, A. Engler (in E. and P., II. Teil, 5. Abth., Bog. 4–6, p. 90) says: "Da in den Handel nur diese und nicht die dazu gehörigen Stengel und B. gebracht werden, so ist schwer zu sagen, zu welchen Arten die einzelnen, anatomisch recht gut unterscheidbaren Handelssorten gehören. Doch wird *S. medica*, Schlecht. et Cham., als Stammpflanze der

Ostmexikanischen oder Veracruz-Sarsaparille. *S. officinalis*, H. B. K., als die der von Jamaika verschifften Sarsaparille, *S. papyracea*, Duham., in Guiana und Brasilien als Stammpflanze der Para-Sarsaparille angesehen; sicher ist mir die Zugehörigkeit der Veracruz-Sarsaparille zu *S. medica*."

RHUBARB.

U. Dammer, after considering the systematic features of the genus Rheum and the historical facts pertaining to rhubarb (E. and P., III. Teil, 1. Abth., Bog. 1–3, p. 22), says:

"Zu unterscheiden ist zwischen Kron[1]- u. Canton[2]-Rhabarber. Erstere stammt, wie durch Przewalski unzweifelhaft festgestellt wurde, von *Rheum palmatum tanguticum* (s. "Gartenflora," 1875, p. 3, und 1882, p. 166), letztere von *Rheum officinale*, Baill. Vielleicht geben aber auch andere *Rheum*-Arten echte Rhabarber-sorten. So wurde lange zeit *Rheum australe*, Don, im Himalaya als echte Rhabarber betrachtet und wahrscheinlich liefern auch einzelne in Centralasien wachsende Arten, wie *R. leucorrhizon*, Pall., und die klein- und dickblattrigen Formen von *R. rhaponticum*, L., des Wesetnes Chinas echte Rhabarber, d. h., Wurzeln, die mehr wonderiger die gleichen Eigenschaften haben."

Not only were the results of these authorities considered, but also the investigations of others, as is seen, particularly, in the paragraphs relating to Myrrh,[3] Balsam of Tolu[4] and Storax.[5]

It is not a question, however, as to which of these experts is right, as this cannot be definitely settled at the present time; but what shall be the attitude of the Pharmacopœia in regard to the results of the labors of the different experts? The writer said, in the editorial note referred to, that "the question of the origin of

[1] Moskowitsche, russische oder Kronrhabarber (Radix Rhei moscowitici s. optimi).

[2] Chinesische, ostindische oder Canton-Rhabarber.

[3] Myrrh.—E. M. Holmes in *Pharm. Jour.*, 1899, p. 295.

[4] In the National Dispensatory, p. 321, is the statement that "Professor Baillon regards the tree yielding Peru Balsam as identical with this [the tree yielding Tolu Balsam.—H. K.], and the difference of the two products as due to the manner in which they are extracted."

[5] Under Liquidambar, the National Dispensatory (p. 946) contains the statement that: "It will be observed that sweet gum agrees in composition with Storax, which, in addition, contains water mechanically mixed with it."

drugs is in some cases still obscure, and in other cases greater freedom should be given in the selection of commercial varieties." Why should the U.S.P. say that Rheum is "the root of *Rheum officinale*, Baillon, and not recognize with the B.P. and other authorities that the commercial rhubarb is likely to be the product of a number of species of Rheum?" Why should the B.P. say that Jamaica sarsaparilla is yielded by *Smilax ornata*, Hook f., when experts seem to recognize that the origin of all the sarsaparillas, except the E. Mexican or Vera Cruz root, is open to question? Why should not the pharmacopœial authorities recognize that in some cases more than one species may yield the commercial drugs and take cognizance of all the results of acknowledged experts?

Instead of limiting the number of species, when questions of doubt exist as to that number, the Pharmacopœia should append to its definition of such drugs a clause that "probably or possibly other species also yield the drug;" such as, for instance, in the case of Myrrh, Copaiba, etc., as the B.P. has done.

If there is any difference in the Myrrh, Copaiba or other drug from different species and sources, this can be provided for under descriptions, tests, etc.

Surely no objection can be raised to this attitude on the question, as it represents the actual conditions, and one which is not only in accord with, and worthy of pharmacopœial authority, but which will create additional confidence in the work as being nearer the truth.

Another point touched upon in the editorial note is one that Mr. Holmes does not refer to, but which is also of importance from the practical consideration of definitions in the Pharmacopœia. The U.S.P. defines Belladonnæ Folia as "the leaves of *Atropa Belladonna*, Linné," and describes under this drug only the leaves. The B.P. defines Belladonnæ Folia as "the fresh leaves and branches of *Atropa Belladonna*, Linn., collected when the plant is in flower," and describes the stems, leaves and flowers. The commercial drug contains generally not only stems, leaves and flowers, but also fruits, and the Pharmacopœia would do well to limit the amount of these different parts of the plant, as at times the drug is made up almost entirely of stems and some leaves, few if any flowers being present, while at other times there is an abundance of flowers and immature fruits.

Investigators of drugs too frequently do not seem to recognize that other parts of the plant yielding the drug, as well as parts of entirely different plants, are present in the commercial drugs—not necessarily as adulterants, but because the price of labor does not warrant evidently a careful garbling.

Not long ago a series of experiments were carried on by one of the students of the Philadelphia College of Pharmacy on Crocus (*Amer. Jour. Pharm.*, 1900, p. 119), and it was shown that none of the commercial drug was more than 90 per cent. pure (*i. e.*, contained only 90 per cent. stigmas) and that the commercial article ranged in purity from 46 to 90 per cent. (*i. e.*, contained 46 to 90 per cent. of stigmas). A reviewer, in commenting upon these results, said that he presumed they referred to powdered saffron, as the crude drug examined by him had been exceptionally pure. This comment shows still further the liability to err on this subject and how frequently even those who handle drugs continually are deceived as to their actual quality and value.

It is to be regretted that the Pharmacopœia gives sanction to the deception by presenting a standard which it is impossible to attain in many instances. In view, then, of this condition of affairs I still maintain that "there are a number of groups of drugs to which rather stringent definitions, descriptions and limits of admixture may be applied, as in seeds, fruits, roots, barks and flowers. In other cases, the difficulty of giving specific definitions is very clear, as for example, in the case of leaves and herbs, rhizomes and plant exudations. To say that certain drugs consist 'chiefly' of certain parts covers the ground a little better, *e.g.*, Crocus, chiefly of stigmas; Chondrus, chiefly of Chondrus crispus, etc. It would be better, however, if the amount of actual drug present in the commercial product could be given."

CONCLUSION.

Every botanist appreciates the difficulties connected with the nomenclature question and there should be some one guide that we can in the main follow. In the United States at least, the work of Engler and Prantl is becoming to a certain extent recognized as the authority on this question.

This is true also in regard to the origin of drugs, but neverthe-

less, every expert investigator should be given credit for his work, and where differences of opinion hold the Pharmacopœia should be more general in its definitions and define the drugs to which these differences apply as being obtained from "probably other species" and as "consisting chiefly of" certain plant parts. Furthermore, in the description of properties and tests the limit of impurity or admixture could be defined; or, in other words, definitions and descriptions, as well as tests, should be based upon the article in the market.

REVIEWS AND BIBLIOGRAPHICAL NOTICES.

A HANDBOOK OF INDUSTRIAL ORGANIC CHEMISTRY adapted for the use of manufacturers, chemists and all interested in the utilization of organic materials in the industrial arts. By Samuel P. Sadtler. Third revised and enlarged edition. Philadelphia: J. B. Lippincott Company.

The first edition of this work was published in 1891 and the second in 1895. At the time of the publishing of the first edition there was no concise work in the English language treating of applied organic chemistry, and the book was a welcome addition to works on chemical technology. Since that time the value of the work has been shown by the necessity for two revisions and the translation of the book into German.

The contents of the book consist of a concise treatment of fourteen different classes of industries, including the following particulars of each: (*a*) Raw Materials; (*b*) Processes of Treatment; (*c*) Products; (*d*) Analytical Tests and Methods; (*e*) Bibliography and Statistics. The classes of industries treated of are the following: (1) Petroleum and Mineral Oil Industry; (2) Industry of the Fats and Fatty Oils; (3) Industry of the Essential Oils and resins; (4) The Cane Sugar Industry; (5) The Industries of Starch and its Alteration Products; (6) Fermentation Industries, including: (*a*) Nature and Varieties of Fermentation; (*b*) Malt Liquors and the Industries Connected Therewith; (*c*) The Manufacture of Wine; (*d*) Manufacture of Distilled Liquors or Ardent Spirits; (*e*) Bread-Making; (*f*) The Manufacture of Vinegar; (7) Milk Industries; (8) Vegetable Textile Fibres, including: (*a*) Paper-making; (*b*) Guncotton, Pyroxyline, Collodion and Celluloid; (9) Textile Fibres of Animal Origin; (10)

Animal Tissues and Their Products, including: (*a*) Leather Industry; (*b*) Glue and Gelatine Manufacture; (11) Industries based upon Destructive Distillation, including: (*a*) Destructive Distillation of Wood; (*b*) Destructive Distillation of Coal; (12) The Artificial Coloring Matters; (13) Natural Dye Colors; (14) Bleaching, Dyeing and Textile Printing. In the appendix are given: (*a*) The Metric System; (*b*) Tables for Determination of Temperature; (*c*) Specific Gravity Tables; (*d*) Alcohol Tables; (*e*) Physical and Chemical Constants of Fixed Oils and Fats.

It will be seen that this handbook is not only a technology, but also an analytical industrial organic chemistry. The manner of treatment of the industries considered is clear, concise and from the point of view of one having a large amount of practical experience. There are 126 illustrations and 16 diagrams showing outlines of processes employed in the different industries. The book is not only valuable from the standpoint of the manufacturer and chemist, but is equally valuable as a text-book for universities and schools of technology where industrial organic chemistry is being taught.

The present revised edition has been brought up to date by the incorporation of the results of progress in the different industries during the past five years. Some of the chapters, in fact, as those on the natural and artificial dye colors, have been largely rewritten. The progress in the applied sciences is so remarkable that books become antiquated in a comparatively few years. On the other hand, there is so much being published in regard to methods which at first seem plausible, but which in a few years may be found to be wholly erroneous or impracticable. It is therefore necessary, in order for books to be safe, that revisions be not too frequent. On the other hand, if they are to be up-to-date revisions they must not be delayed too long. The experience of the past 10 years indicates that in not only the conception of this handbook, but in its revisions, the author has been singularly fortunate, and the third edition, which has been thoroughly revised and brought up to date, is to be recommended.

STUDENTS' EDITION, A PRACTICAL TREATISE OF MATERIA MEDICA AND THERAPEUTICS, with special reference to the clinical application of drugs. By John V. Shoemaker. Fifth edition. Thoroughly revised. 6¼ x 9½ inches. Pages vii–770. Extra cloth, $4 net; sheep, $4.75 net. F. A. Davis Company, publishers, 1914-16 Cherry Street, Philadelphia.

The author's experience has led him to change the scope of the fifth edition of his Materia Medica and Therapeutics, and he has decided to divide the work into two independent issues: (*a*) the students' edition, which has been just issued; (*b*) and the physicians' edition. In the students' edition the drugs are limited to those of the Pharmacopœias of the United States and Great Britain. The physicians' edition, it is presumed, will be much more comprehensive.

The present students' edition is a valuable work on the clinical application of drugs. One of the most fortunate things in the book is the author's preface concerning the use of the metric system of weights and measures. The author says: "It is, no doubt, destined eventually to supersede the older system so long employed in English-speaking countries. The metric system has the important advantage of establishing a uniformity of notation throughout the civilized world. In order to facilitate its universal adoption, it is desirable that the student should be trained in its use from the beginning of his professional course." The book is divided into two parts, Part I treating of (*a*) General Considerations Concerning Remedies and Systems of Treatment; (*b*) Pharmacology and the Pharmacopœia; (*c*) Materia Medica; (*d*) Pharmacy; (*e*) Prescription Writing and Formulæ; (*f*) Poisons and Antidotes; (*g*) General Therapeutics and Classification of Remedies. In Part II are given the pharmacology, physiological action and therapy of drugs of the U.S.P. and B.P. The work is in reality one treating primarily of the clinical application of remedial agents. The author unfortunately does not make clear the distinction between medicines and drugs, and uses the term pharmacology as meaning the description and physical properties of drugs. The book has incorporated into it the results of the more recent clinical investigations, contains numerous formulæ and much valuable information concerning the clinical application of remedial agents.

General Vegetable Pharmacography. By Albert Schneider. Chicago: Chicago Medical Book Company.

This book of 136 pages is designed to serve as a supplement to any of the existing text-books on vegetable pharmacography, and treats of the following subjects:

(1) General Discussion of the Senses,

(2) Special Discussion of the Senses with Reference to the Examination of Vegetable Drugs.

(3) Causes Modifying the Characteristics of Drugs.

(4) The Histology of Vegetable Drugs.

The book will no doubt prove of value to students who are engaged in a study of vegetable drugs.

A TEXT-BOOK OF CHEMISTRY. By Samuel P. Sadtler and Virgil Coblentz. Being the third revised and enlarged edition of Sadtler and Trimble's Chemistry. In two volumes. Philadelphia: J. B. Lippincott Company.

The appearance of another revised and enlarged edition of this well-known chemistry in two years speaks for the value of this book. The new edition is characterized by an enlargement of the part dealing in elementary physics, electrolysis and electro-metallurgy and the periodic system. In the chapters on physics over fifty new illustrations alone have been added. In thus developing the part on elementary physics, the authors have shown excellent judgment. The student in pharmacy and the applied sciences cannot have too much of the fundamental training in physics—indeed, a physical laboratory is to-day almost to be considered essential to the proper understanding of natural phenomena and the application of such knowledge in the construction of apparatus for use in the arts and sciences. No man can be a successful manufacturer who is not familiar, both theoretically and practically, with the general and special properties of matter and energy, and who is not well acquainted with the nature and application of heat, light and electricity. Probably the most fertile of all the departments of physics is that relating to electricity. The applications of electricity are seen on every hand. In chemistry it is applied to electro-chemical analysis, electrotyping, electroplating, electric refining of metals, electrolysis of alkali chloride, electrolytic preparation of hypochlorites, chlorates, caustic alkalies, metallic arsenic and antimony, ozone, white lead, the carbides, phosphorus, iodoform, chloral, chloroform, nitro-compounds, saccharine, organic colors, etc. The present edition contains a concise treatment of the processes involved in the above-enumerated applications.

The new edition, which has been enlarged and thoroughly revised, contains all of the valuable features of the earlier editions,

and it is highly probable that there is no chemistry published in the English language for the use of medical and pharmaceutical students that treats so concisely, thoroughly and accurately of the departments of physics and chemistry and their application in medicine and the arts.

MINUTES OF THE PHARMACEUTICAL MEETING.

The third of the series of pharmaceutical meetings of the Philadelphia College of Pharmacy, for 1900–1901, was held on Tuesday, December 18, 1900. James T. Shinn, a well-known member of the College, presided. The meeting was an exceptionally valuable one owing to the number of practical matters that were discussed. Dr. Henry Leffmann spoke on the subject of high and low explosives, exhibiting samples of the powders used in modern warfare; also giving a few practical demonstrations of the mode of action of explosives. His address was in part as follows:

"Various mixtures of a more or less explosive character were used in ancient times. Greek fire is believed to have been a mixture of bituminous matters, nitre and sulphur. This would burn under water and was used with great destructive effect before the invention of firearms. Cannon were used over five hundred years ago. It is stated that the cannon used at the siege of Constantinople in 1453 was fired only about eight times a day.

"The increase in the size of cannon in modern times has necessitated increase in the size of the grains of powder, because a very fine grain powder would be too powerful. I have here specimens of the large hexagonal grains of ordinary black powder, also the brown powder, the latter containing a charcoal of lighter color. These specimens are intended for the large cannon. Here are cubical grains about the size of common dice intended for rapid-fire guns, also spherical grains about ½ inch in diameter. Another interesting class is that in which sodium nitrate is substituted for potassium nitrate. Contrary to what I have always been taught, this powder is not appreciably deliquescent. The use of the sodium compound is, of course, for the sake of economy. These powders are used for mild blastings, such as getting out coal. Here is a sample of Dupont's CCC grade, the grains of which are nearly as large as peach-kernels.

"Modern high explosives are essentially nitro-compounds, forms of nitrocellulose or nitroglycerin. The solubility of nitrocellulose in volatile solvents permits of forming it into any shape or mixing it with any substance. Some of the common smokeless powders are similar to celluloid. The formulæ are often secret, but nitrocellulose is the foundation ingredient. Here is one of the ribbon forms. Cordite is in cylindrical sticks. Here are short, thick cylinders of the Maxim-Schüpphaus type, perforated as you see with longitudinal openings to permit the free rush of flame through the mass. Several sizes of these are on the table, the largest about 3 inches long by 1 inch in diameter, the smallest 1 inch long by less than a half inch in diameter. When burning in the open air these smokeless explosives do not show much energy, although there is evidently a large gas disengagement with little smoke and very little solid residue. In connection with this experiment it is interesting to note the effect of heating ammonium dichromate, in which an active internal combustion occurs, but the fact that one product, chromic oxide, is solid, greatly diminishes the energy of the combustible, though the action is analogous to that which occurs in guncotton."

J. Percy Remington exhibited and described "A Pharmacist's Apparatus Stand" (see page 19). The chairman, Mr. Shinn, commended the apparatus as having certain very admirable features, and said that when he was actively engaged in the drug business he had constructed a stand for use in a closet in which the space in a vertical direction was utilized.

F. W. Haussmann read a paper on "The Discoloration of Syrup of Iodide of Iron," and exhibited numerous specimens. (See page 16.) Dr. Leffmann, in commenting on the paper, said that possibly the metallic salt caused an inversion of the sugar with consequent discoloration of the syrup, as has been shown in a paper recently by Dr. J. H. Long, of Northwestern University. In reply to a question by Mr. Shinn, as to the use of glycerin in preserving the syrup, Mr. Haussmann said that the question of chemical action arose when this substance is used, as glycerin, being glyceryl hydrate when acted upon by iodine or its compounds, possibly forms allyl compounds as allyl iodide. Mr. Joseph W. England exhibited a specimen from the Museum of the College, which had been made by Professor Procter (this JOURNAL, 1868, p. 108), January 15, 1865, using glycerin, and which was not discolored. He also stated that in making the syrup

care should be taken that the grease should be removed from the iron, and that he had found iron card teeth preferable to iron raspings; also that it was necessary to heat the solution to ensure the end reaction.

Mr. Shinn remarked that he used to put a coil of iron wire in the bottles containing the syrup to ensure the iron being kept in the ferrous state.

Melvin W. Bamford read a paper on "Benzoinated Lard," and exhibited some specimens. (See page 29.) Mr. Wiegand said that he found it best to expose as great a surface as possible to the finely powdered benzoin at as low a temperature as possible, and then strain the product through canton flannel. Professor Lowe referred to Mr. Beringer's remarks made at a previous meeting (see Vol. 72, p. 559), and also to the method of making benzoinated lard which was employed by Mr. Webb. The principle was the same as that referred to by Mr. Wiegand, in that alternate layers of powdered benzoin and lard were digested at a temperature just sufficient to melt the lard. Mr. Shinn remarked that he used to dissolve the benzoin in alcohol and then digest this with the melted lard until the alcohol evaporated, after which the powder was allowed to settle, and when cool the upper part was removed. Mr. Haussmann said that, in his experience, the benzoin in either an alcoholic or ethereal solution was likely to become shredded, particularly in an ointment consisting of lard and wax.

Mr. Bamford said that there was one point to which he desired to call particular attention, that in making leaf lard from the fatty tissues no water was employed, this being the process proposed by Professor Redwood and adopted by the British Pharmacopœia. The usual custom by manufacturers of lard is to wash the lard with water, and some of it is then removed by heat.

In discussing the subject, Professor Kraemer remarked that he was heartily glad that Mr. Bamford had taken up this subject, as it demonstrated what could be done if pharmacists really desired to secure good materials wherewith to make pharmaceutical preparations. It has been supposed that a good leaf lard was very difficult to obtain, and it would appear that the method of making the lard from the animal tissues was an expensive process, whereas Mr. Bamford showed that it was an economical one.

Mr. Kebler read a paper on "The Testing of Essential Oils,"

which was a joint paper by himself and Dr. Pancoast. (See page 1.) Mr. England referred to a commercial specimen of oil of sandalwood, which was found to contain 90 parts of sandalwood oil, 7 parts of alcohol and 3 parts of chloroform. This oil had the same specific gravity as the U.S.P. required, and also answered the tests for solubility. Professor Lowe referred to the fact of the enormous quantity of cloves which is distilled in this country and also to the fact that one large manufacturing house, in order to ensure the purity of oil of sandalwood, imports the sandalwood for distillation. He also referred to the fact of oil of rose being adulterated with oil of ginger-grass and finally stated that he did not see any great harm, therapeutically, in the substitution of oil of birch for oil of wintergreen, as the oil of birch contained nearly all methyl salicylate and the oil of wintergreen 90 per cent. Mr. Kebler further remarked that kerosene is often used to adulterate essential oils, the low boiling kerosene being employed to adulterate the oils having low boiling points and the high fraction kerosene with those having a high boiling point. H. K.

AMERICAN PHARMACEUTICAL ASSOCIATION.

The next meeting of the Association will be held at St. Louis, September 16–21, 1901.

The Section on Practical Pharmacy and Dispensing announces the following:

Through the generosity of Dr. Enno Sander, Ex-President of the American Pharmaceutical Association, the Practical Pharmacy and Dispensing Section is enabled to offer *a Cash Prize of Fifty Dollars* for the most worthy paper or report presented to it, upon the following conditions: (1) All competitors must be members of the American Pharmaceutical Association, and actively engaged in the retail drug business—principals and assistants equally acceptable—and shall not be connected with the teaching department of any school or college of pharmacy. (2) The subject discussed or reported upon shall be within the scope of pharmaceutical manipulations, dispensing or the actual doings of a retail drug store. (3) All competing papers or reports must be in the hands of the Secretary of the Section, F. W. E. Stedem, Corner Broad Street and Fairmount Avenue, Philadelphia, Pa., on or before July 1, 1901, and must be marked "For competition."

❋ CLASSES ❋

OF THE

PHILADELPHIA COLLEGE OF PHARMACY,

Eightieth Annual Session, 1900-1901.

FIRST YEAR CLASS LIST.

Name.	*Place.*	*State.*	*Preceptor.*
Adams, John Howard,	Reading,	Pa.	W. Scott Adams.
Albert, Howard,	Freeland,	Pa.	M. E. Grover.
Allen, Robert Wallin,	Philadelphia,	Pa.	Funk & Groff.
Ames, Arthur Garfield,	Vineland,	N. J.	Bidwell & Co.
Anthony, Herbert Spencer,	Reading,	Pa.	P. A. Dietrich, P.D.
Armstrong, Joseph Massey,	Church Hill,	Md.	Dr. R. L. Lindsay.
Atkinson, Mary Elizabeth,	Altoona,	Pa.	Dr. G. W. Wood.
Baas, Charles Wesley,	Scranton,	Pa.	S. L. Foulke.
Baker, Victor Louis,	Bridesburg, Phila.,	Pa.	Wm. Morrett.
Bachman, Harry Stanley,	Philadelphia,	Pa.	Samuel Evans, Jr.
Babbitt, Theodore Perley,	Brattleboro,	Vt.	Geo. E. Greene.
Bailey, Clarence Matthews,	Zanesville,	Ohio.	Bailey Drug Co.
Banta, Edwin, Jr.,	Lansdowne,	Pa.	Harry M. Davis.
Berry, Lawrence Frank,	Charlestown,	W. Va.	Robert T. Berry.
Bibby, David Boone,	Catawissa,	Pa.	
Billetdoux, Chester Augustus,	N. Adams,	Mass.	George A. Hastings.
Billups, James Sykes,	Columbus,	Miss.	Freeman & Pettyjohn.
Bonta, Clarence LaRue,	Hanover,	Ind.	A. B. Morse.
Boyd, Guy Stephen,	York,	Pa.	Dale & Co.
Brunhouse, Harry Franklin,	York,	Pa.	F. Brunhouse.
Buchert, Charles Frederick,	Philadelphia,	Pa.	John B. Reynolds.
Burkholder, Lloyd Amadore,	Shippensburg,	Pa.	Fleming & Fleming.
Burt, Arthur Henry,	Elmira,	N. Y.	J. P. Kelly.
Chambers, Francis J.,	Atlantic City,	N. J.	E. S. Reed's Sons.
Coleman, William Fogg,	Nicetown, Phila.,	Pa.	Mahlow Kratz.
Cooney, William Francis,	Florence,	Mass.	
Cooper, Clyde,	Lancaster,	Pa.	H. M. Snyder.
Cornwell, Joseph Clark,	New London,	Conn.	Moon's Pharmacy.
Cossaboom, Herbert Solomon,	Bridgeton,	N. J.	Wm. Clarence Berger.
Crossley, Samuel Wallace,	Corpus Christi,	Tex.	Andrew Blair & Co.
Currinder, Alva,	Wilmington,	Del.	N. B. Danforth.
Curtis, Frank Duezze,	San Jose,	Cal.	
D'Alemberte, Herbert Harry,	Pensacola,	Fla.	Ernest W. Petterson.
Dana, Clyde,	Caledonia,	Ohio.	C. E. Kelly.
Daub, Charles Melvin,	Norristown,	Pa.	Bunting & Yeakle.
Davis, Howard Sherman,	Reading,	Pa.	Smith, Kline & French Co.
Davis, John Hall,	Lansdowne,	Pa.	Harry M. Davis.
Davis, Thomas Carroll,	Thorndale,	Pa.	G. N. Thompson.
Decker, Harry Francis,	Johnstown,	Pa.	Chas. Griffith.
Desher, Edward Winert,	Philadelphia,	Pa.	
Dilks, John,	Philadelphia,	Pa.	Harmon Dilks, Jr.
Donnelly, William Michael,	Salem,	N. J.	C. A. Eckels.

Name.	*Place.*	*State.*	*Preceptor.*
Dubbs, Carbon P.,	Pittsburg,	Pa.	
Ebert, James Monroe,	Gordon,	Pa.	J. E. Gregory.
Eccles, Byron Jackson,	DeLand,	Fla.	Geo. W. Fisher.
Edwards, Lawrence,	Trackville,	Pa.	Dr. David Taggart.
Eichold, Bernard Herbert,	Mobile,	Ala.	Mobile Drug Co.
Eldridge, Roy Kerr,	Coldwater,	Mich.	
Everham, H. Valentine, Jr.,	Ambler,	Pa.	
Eyster, Geo. William,	York,	Pa.	W. E. Boose.
Fox, Miss Jamella,	Tamaqua,	Pa.	N. A. Porter.
Fox, Morris Wayne,	South Bethlehem,	Pa.	M. M. Buss.
Fralinger, John Joseph,	Philadelphia,	Pa.	Dr. T. H. McFarland.
French, Leroy Brown,	Houlton,	Me.	O. F. French.
Frantz, Geo. Adam,	Lebanon,	Pa.	Pretzel's Pharmacy.
Gable, Edmund James,	Reading,	Pa.	Harry J. Schad.
Galbraith, Wm. H., Jr.,	Germantown, Phila.,	Pa.	W. H. Galbraith.
Galer, Fread. Joseph,	Philadelphia,	Pa.	H. G. Kalmbach.
Gamer, Albert Chas. C.,	Tamoca,	Wash.	Dr. W. H. Kellogg.
Garvey, Joseph Peter,	Philadelphia,	Pa.	J. Francis Hauck.
Geiger, Fredk. Luther,	Pillow,	Pa.	E. E. Wilson & Co.
Geisking, John Leroy,	Harrisburg,	Pa.	J. Wilson Hoffa.
Gerson, Dora Goldie,	Muscow,	Russia.	
Glaspell, Wm. English,	Bridgeton,	N. J.	Chas. F. Dare & Son.
Gould, Lewis Elms,	Presque Isle,	Maine.	S. W. Boone & Co.
Gladfelter, Wilford Stanley,	Seven Valley,	Pa.	
Griggs, Alfred,	Sandwich,	England.	I. E. McNair.
Guier, Luis Javier,	Cartago,	Costa Rica.	Guillero Guier.
Guthrie, Ira Culpepper,	Temple,	Texas.	W. E. Willis.
Harbold, John Tilden,	York,	Pa.	R. W. Zeigler.
Harbaugh, Duncan James,	Haverford,	Pa.	W. L. Harbaugh.
Harkness, Edw. Gehring,	Carlisle,	Pa.	Dr. B. F. Emrick.
Harmening, Fredk. H.,	Defiance,	Ohio.	N. G. Woodward.
Harris, James Nixon,	Millville,	N. J.	M. L. Branin.
Hayn, Herman Ernest,	Springfield,	Mass.	J. H. Manning.
Hecker, Andrew Ned,	Carlisle,	Pa.	John E. Sipe.
Hemmersbach, Henry Wm.,	Philadelphia,	Pa.	E. W. Hermann.
Herflicker, Walter Esterley,	Reading,	Pa.	Wm. P. M. Zeigler.
Hetherington, Jas. Norton C.,	Philadelphia,	Pa.	Thos. Hetherington.
Hoerner, Guy Hoover,	Mechanicsburg,	Pa.	C. A. Eckels.
Hoey, Alexander,	Philadelphia,	Pa.	Edw. C. Stout.
Holcombe, John Heisler,	Bridgeton,	N. J.	David H. Holcombe.
Holstein, Geo. Leon,	Lebanon,	Pa.	Geo. W. Schools.
Hoover, Robert Adams,	Du Bois,	Pa.	Mr. A. P. Holland.
Howard, Carrie Elizabeth,	Philadelphia,	Pa.	Carrie E. Howard.
Johnson, Edw. Thomas,	Philadelphia,	Pa.	Wm. B. Lentz.
Johnson, Chauncey Nicholas,	Uniontown,	Pa.	H. S. Clark.
Jones, Edw. DeMaur,	Philadelphia,	Pa.	
Jones, Clarence,	Doe Run,	Pa.	W. R. Sharp.
Jones, Virginia Violetta,	Wilkesbarre,	Pa.	
Keener, James Blaine,	Middletown,	Pa.	John W. Renalt.
Keller, Martin Luther,	Steelton,	Pa.	W. K. Martz.
Kempte, Floyd Budd,	Mt. Holly,	N. J.	Elmer D. Prickett, M.D.
King, Grant Wagner,	Lafayette,	Ind.	Wm. A. Musson.
Kisner, Geo. Williamson,	Belmar,	N. J.	Bloomfield Hulich.
Klein, Frank Bengler,	Henderson,	Ky.	W. S. Johnson & Son.
Koons, Chas. Eyster,	Harrisburg,	Pa.	E. Z. Gross.
Leaman, John Benjamin,	Strasburg,	Pa.	J. M. Tronsfield, Jr.
Lebo, Chas. Spears,	Lebanon,	Pa.	Chas. H. Blouch.
Lee, Robert Edward,	Carlisle,	Pa.	J. E. Seebold.
Light, Chas. Augustin,	Lebanon,	Pa.	John F. Loehle
Linde, Henry Mohre,	Philadelphia,	Pa.	Robert McNiel.

Name.	*Place.*	*State.*	*Preceptor.*
Lisser, Joseph North,	Haddonfield,	N. J.	Frank P. Rogers.
Lord, Geo. Washington, Jr.,	Haddonfield,	N. J.	
Loyer, Marcus Brownson,	Philadelphia,	Pa.	Chas. A. Eckels, Ph.G.
McGuire, Jos. Francis,	Mahanoy City,	Pa.	Thos. E. McGuire.
McHale, Chas. Joseph,	Shenandoah,	Pa.	Paul W. Houck.
Mader, James Wilson,	Shenandoah,	Pa.	J. B. Moore.
Malloy, Westley General,	Philadelphia,	Pa.	Addington LaDow.
Markle, Howard Overholt,	New Haven,	Pa.	T. J. Connell, P.D.
Marvin, Joseph,		Germany.	
Mayers, James Curtis,	Piney Creek,	Md.	C. Carroll Meyer.
Mayerson, Frances Rose,	Philadelphia,	Pa.	M. Peissakovitch.
Mershon, Ray,	Easton,	Pa.	Edward K. Cope.
Michael, Horace,	Lebanon,	Pa.	Charles A. Boger.
Monroe, Frank D. Montague,	Logan,	O.	F. W. E. Stedem.
Montgomery, John Hinks,	Bucksport,	Me.	Richard B. Stover.
Moore, Augustine Curtis,	Portsmouth,	Va.	C. J. Brownley.
Morgan, Harold Bertram,	Philadelphia,	Pa.	Frank E. Morgan.
Moyer, Lewis Nathan,	Reading,	Pa.	E. M. Boring.
Musson, Katharine Johanna,	Philadelphia,	Pa.	Wm. A. Musson.
Neiler, Wm. Mackie,	Philadelphia,	Pa.	Wm. A. Whitten.
Newman, Marguerite May,	Ontario,	Ore.	Snyder & Newman.
Newhard, Jas. Gillespie B.,	Fernwood,	Pa.	Chas. E. Keeler.
Newton, Clyde Burdick,	Findlay,	O.	Newton Bros.
Pitts, Milton Warren,	Lynn,	Mass.	
Plaster, John Edgar,	Charlotte,	N. C.	Woodall & Sheppard.
Prosser, Elmer Oscar,	Hellertown,	Pa.	Cyrus Jacoby.
Prowell, Tolbert,	Steelton,	Pa.	Dr. W. R. Prowell.
Raker, Edward Heller,	Pillow,	Pa.	John W. Raker.
Reburn, Albert Randolph,	Oxford,	Pa.	Miss Millie Baker.
Reading, Augustus R.,	Lambertville,	N. J.	Geo. M. Shamalia.
Reed, James Garfield,	Taffin,	O.	D. S. Fergerson.
Roth, Emil Krieger,	Johnstown,	Pa.	Kredel & Farrel.
Rothwell, Eugene,	Willow Grove,	Pa.	Robert S. Doake.
Rubin, Dora,	Oremburg,	Russia.	Dr. Joffe.
Schmidt, Otto Waldemar,	Canton,	O.	Henry Mueller, M.D.
Shiffer, Daisy Rhodes,	Hudson,	Pa.	Bert B. Shiffer.
Shillito, Chas. Emmert,	Waynesboro,	Pa.	Mentzer & Clugston.
Shrenk, Murray Hamilton,	Harrisburg,	Pa.	W. R. Laird.
Shull, David Frank, Jr.,	Philadelphia,	Pa.	D. F. Shull & Co.
Shulte, Frank Xavier,	Philadelphia,	Pa.	Dr. Emil Jungmann.
Smith, Clarence,	Philadelphia,	Pa.	G. Y. Wood.
Smith, Frank G. D.,	Grand Forks,	N. D.	
Smith, Henry Addison,	Binghampton,	N. Y.	C. W. Knape.
Smith, Jacob Schall,	York,	Pa.	Wm. Smith & Co.
Snyder, David Stahl,	Somerset,	Pa.	G. W. Benford.
Sognis, Michael James,	Trenton,	N. J.	Mary M. Tidd.
Stallsmith, Walter Edward,	Parsons,	Pa.	Henry H. James.
Still, Israel Thomas,	Boston,	Mass.	H. C. Blair.
Stimmel, Irvin Sigfried,	Kutztown,	Pa.	N. F. Weisner.
Stine, W. Earl,	Williamsport,	Pa.	R. P. Blackburn.
Stolz, David,	Syracuse,	N. Y.	Geo. E. Thorpe.
Strayer, Francis Williard,	York,	Pa.	Wm. Smith & Co.
Stuck, Williard Stearns,	Miffinburg,	Pa.	J. H. Sterner.
Stump, Frank Arthur,	Harrisburg,	Pa.	J. W. Cotterel.
Sutliff, Jacob,	Bloomingdale,	Pa.	E. F. Swartz.
Taggart, Alexander H. Supplee,	Norristown,	Pa.	G. C. Taggart.
Tripmaker, Walter Wm.,	Philadelphia,	Pa.	E. H. Fienhold.
Tuohy, James Louis,	Woodstown,	N. J.	Geo. M. Andrews.
Van Dyke, James P.,	Sunbury,	Pa.	James Van Dyke.
Walmsley, Chas. Edward,	Philadelphia,	Pa.	Aquila Hock, Ph.G.
Welsh, Ralph Lignori,	Altoona,	Pa.	R. E. Welsh.

Name.	*Place.*	*State.*	*Preceptor.*
Wilson, Harry William,	Wappinger's Falls,	N. Y.	Geo. H. Howarth.
Wolford, Walter James,	Allen,	Tex.	J. P. Harding.
Wolf, Wm. Aloysius,	Reading,	Pa.	F. X. Wolf.
Woodside, Jno. Montgomery,	Danville,	Pa.	W. J. Pechin.
Young, Samuel,	Philadelphia,	Pa.	L. C. Funk.
Zimmerman, Chas. Sumner,	York,	Pa.	W. L. Smyser.

SECOND YEAR CLASS LIST.

Name.	*Place.*	*State.*	*Preceptor.*
Ackerman, Wm. Brown,	E. Mauch Chunk,	Pa.	Geo. L. Cainan.
Allen, Edwin Cullom,	Philadelphia,	Pa.	Dr. O. E. Henritzy.
Alston, Wm. Algeron,	Haygood,	S. C.	J. B. Cook.
Anderson, L. C.,	Reading,	Pa.	H. H. Kline.
Ashmead, Virden P.,	Philadelphia,	Pa.	Anna S. Ashmead.
Bacon, Vela,	Freehold,	N. J.	Bacon & Pittinger.
Baer, Herbert Oscar,	Wheeling,	W. Va.	W. S. Dickson.
Baker, Daniel,	Bellevinon,	Pa.	
Beegle, David Elmer,	Bedford,	Pa.	Heckerman Drug Co.
Bair, Edward Elmer,	York,	Pa.	John S. Weakley.
Bell, Herman Alonzo,	Philadelphia,	Pa.	Theodore Campbell.
Berberich, Joseph Herman,	Stein,	Germany.	James Moffet, Jr.
Binder, Arthur Henry,	Titusville,	Pa.	F. W. Renting.
Blew, Robert Sinclair,	Bridgeton,	N. J.	P. W. Shull.
Blough, Elijah Robert,	Holsopple,	Pa.	A. D. Yoder, M.D.
Bornemann, John Alexander,	W. Philadelphia,	Pa.	Dr. W. H. Hickman.
Boyer, Walter Ernest,	Danville,	Pa.	F. Ross Horner.
Brown, Horsey P.,	Wilmington,	Del.	Z. James Belt.
Brown, Joel Daniel,	Philadelphia,	Pa.	
Bryant, James Robeson,	Stroudsburg,	Pa.	W. H. Umstead.
Caden, Alice Beatrice,	Lexington,	Ky.	McAdams & Morford.
Catlin, Jos. Albert,	Church Hill,	Md.	Jos. J. Kelly.
Clemmer, John Krupp,	Lansdale,	Pa.	C. J. Biddle.
Craven, Alfred Young,	Bridgeport,	Pa.	Harry Lee Randall.
Crawford, Thos. Foster,	Camden,	N. J.	C. B. McLaughlin.
Croft, Clarence,	Chambersburg,	Pa.	C. L. Giger & Co.
Crothers, Anthony Brooks,	Zion,	Md.	J. L. Crothers.
Dickinson, Ralph Brinton,	Parkesburg,	Pa.	Charles Leedon.
Dix, Robert Youngs G.,	Moorestown,	N. J.	G. H. Wilkinson.
Douglass, John Xavier,	Philadelphia,	Pa.	D. J. Reese.
Downs, Wm. Joseph,	Coaldale,	Pa.	John H. Bailey.
Dufford, J. Albert,	West Sunbury,	Pa.	J. T. Miller.
Eckels, Nathaniel Ort,	Shippensburg,	Pa.	W. G. Nebig.
Evans, Thomas John,	Plymouth,	Pa.	Geo. J. Durbin.
Eves, Charles Scott,	Millville,	Pa.	Charles S. Eby.
Evrard, John Joseph,	Bethlehem,	Pa.	Geo. D. Kressler.
Faust, Peter Wenner,	Claussville,	Pa.	H. L. Kiper.
Fetterolf, Clarence F. G.,	Ashland,	Pa.	H. C. Stiles.
Filman, Walter Theodore,	Warwick,	Pa.	H. L. Klopps.
Fitch, James Clarence,	Philadelphia,	Pa.	Dr. P. Fitch.
Fleischer, Wm. Paul,	Philadelphia,	Pa.	Dr. Frank E. Johnson.
Fox, Irvin Berry,	Lebanon,	Pa.	J. L. Lemberger & Co.
Fox, Joseph Peter,	Philadelphia,	Pa.	Peter P. Fox, Sr.
Fried, Percy,	Allentown,	Pa.	Frank P. Semmel.
Gage, Luther Hendrick,	Luraysville,	Pa.	W. D. Johnson.
Gearhart, Malcolm Zieber,	Reading,	Pa.	S. S. Stevens.
Gehringer, Edwin Franklin,	Allentown,	Pa.	O. B. J. Haines.
Geron, Yeatman,	Huntsville,	Ala.	J. D. Humphrey & Son.
Gettel, John Ralph E.,	Shippensburg,	Pa.	J. C. Altick & Co.

Name.	*Place.*	*State.*	*Preceptor.*
Goodman, Edith Morton,	Denver,	Col.	Dr. Susan Hayhurst.
Goring, Myatt Edward,	Wappinger Falls,	N. Y.	George Howarth.
Grove, Harry Ross,	Alexandria,	Pa.	Russell T. Blackwood.
Handwork, Francis C.,	Birdsboro,	Pa.	R. Clark.
Hanington, Bertram John,	New Brunswick,	Canada.	Mr. Yeaby, Manager.
Hawkins, Louis J.,	Coatesville,	Pa.	W. S. Young.
Hayes, John Gilbert,	St. Clair,	Pa.	I. Cohen.
Heffelfinger, Wm. Edward,	Reading,	Pa.	J. H. Stein.
Hendrickson, Raymond,	San Francisco,	Cal.	W. H. Gano.
Hertzler, Norman Eberley,	Philadelphia,	Pa.	Fred. Brown Co.
Hertzler, Oliver Henry,	Lancaster,	Pa.	C. A. Heinitsh.
Hilliard, Bayard,	Vincenttown,	N. J.	F. F. Hilliard.
Hibbs, Wm. Buckman,	Newtown,	Pa.	Walter R. Elliott.
Hougendobler, Harry Smaltz,	Columbia,	Pa.	L. H. Hirst.
Irwin, John Henry,	Philadelphia,	Pa.	Alex. Wilson.
Jago, Harry W. Garfield,	Millville,	N. J.	R. L. Haus.
Jefferis, Charles Albert,	Philadelphia,	Pa.	Funk & Groff.
Jones, Howard Harlan,	Norristown,	Pa.	Atwood Yeakle.
Kane, Augustin Francis,	Brooklyn,	N. Y.	F. F. Drueding.
Kellar, William Albert,	Denver,	Col.	Dr. Ballantine.
Kirk, Frank H.,	Curwensville,	Pa.	Shinn & Baer.
Knabb, Daniel Milton,	Limekiln,	Pa.	W. H. Reeser.
Knauss, Howard James,	Allentown,	Pa.	Dr. R. C. Peters.
Koller, Charles Joseph,	Altoona,	Pa.	C. G. Neeley.
Kyle, Christian B.,	Middletown,	Pa.	Chas. E. Bauer.
Lebegern, Barton,	Columbia,	Pa.	Eberly Brothers.
Lescure, Anna Rosalie,	Philadelphia,	Pa.	Dr. John B. Chapin.
Lewis, Herbert Williard,	Springfield,	Mass.	Harry P. Elsey.
Lide, Leighton Elba,	Columbus,	Miss.	Mayo & Weaver.
McGarrah, Wm. Henry, Jr.,	Scranton,	Pa.	T. D. MacPhee.
McGregor, Albert Dell,	Maywood,	Ill.	G. M. Beringer.
McLaughlin, Harry Aloysius,	Philadelphia,	Pa.	N. Richardson.
Marcus, Simon,	Philadelphia,	Pa.	W. A. Shannon.
Margolin, Mrs. Fannie B.,	Jico,	Russia.	H. J. Hackett.
Martin, Charles Edward,	Columbia,	Pa.	W. L. Bucher.
Martin, Frederick Adam,	Atlantic City,	N. J.	J. V. Townsend.
Martin, John M.,	Birmingham,	Ala.	W. R. Gunn.
Matlack, Walter Ball,	Bridgeton,	N. J.	Geo. Y. Wood.
Meals, Ira Dale,	Harrisburg,	Pa.	C. T. George, Ph.D.
Meredith, Wilbur Curtis,	Coatesville,	Pa.	R. H. Lackey.
Metzler, Oscar Leroy,	Harrisonville,	Pa.	J. A. Fergusson.
Miller, Roy L.,	Philadelphia,	Pa.	
Myers, Luther M.,	Carlisle,	Pa.	G. B. Evans.
Noble, Harry Carty,	Manayunk, Phila.,	Pa.	Howard M. Leverlug.
Oberly, John S.,	Bethlehem,	Pa.	Walter Crawford.
O'Hanlon, Joseph Thornley,	Pennington,	N. J.	G. W. Scarborough.
Parker, James Heber,	Reading,	Pa.	J. H. Stein.
Phillips, Elliott Earl,	Philadelphia,	Pa.	W. P. Bender.
Quinn, Vincent De Paul,	Lansford,	Pa.	J. A. Quinn.
Ramsaur, David Wilfong,	Palatka,	Fla.	Ackerman & Stewart.
Raum, Harry Angle,	Shippensburg,	Pa.	Fleming & Fleming.
Reeve, Alfred Warfield,	Elmer,	N. J.	Jos. M. Garrison, Jr.
Reice, Isaac Stephen,	Bloomsburg,	Pa.	Moyer Brothers.
Rhodes, Geo. Washington,	Newark,	Del.	Dr. J. B. Butler.
Robinson, David Crogman,	Philadelphia,	Pa.	H. M. Minton, Ph.G.
Robinson, Thomas Holmes, Jr.,	Bealeton,	Va.	L. F. Ringer.
Roeder, Morris Albert,	Schuylkill Haven,	Pa.	Dr. A. A. G. Stark.
Roessler, Harry L.,	Philadelphia,	Pa.	Harry A. Smith.
Rudolph, Harold Clarence,	Pottsville,	Pa.	John P. Frey.
Schiesser, Harry William,	Philadelphia,	Pa.	
Scott, Walter Edward,	Pomeroy,	Pa.	Jas. Grier Long.

Name.	*Place.*	*State.*	*Preceptor.*
Seal, John Horace,	Swarthmore,	Pa.	A. R. Morton, M.D.
Seeley, Chester Belting,	Bridgeton,	N. J.	G. H. Whipple & Son.
Shaw, Saml. Frederick,	Philadelphia,	Pa.	Geo. B. Evans.
Shaw, Wm.,	St. Louis,	Mo.	
Slobig, Charles Henry,	Reading,	Pa.	R. J. Williams.
Smith, Harry Wm.,	Pottstown,	Pa.	E. S. Beshore.
Smith, Karl Walter,	Marietta,	Pa.	R. W. Cuthbert.
Smith, Wm. David Harris,	Jonesboro,	Tenn.	E. B. Jones.
Soken, Joseph Louis,	Zitsmir,	Russia.	Geo. Seldes.
Strauss, Robert Franklin,	Womelsdorf,	Pa.	F. T. Landis.
Stuver, Henry Wm.,	Fort Collins,	Col.	A. W. Scott.
Swineford, Ernest Clarence,	Miffinburg,	Pa.	T. B. Brubaker, M.D.
Swartz, Wm. L.,	Carlisle,	Pa.	Geo. W. Sipe.
Thomas, George Carroll,	Lima,	Pa.	W. P. Wingender.
Toulson, Jno. Milbourn,	Chestertown,	Md.	M. A. Toulson.
Trost, Wm. Christian,	Ashland,	Pa.	A. Schoenenbergh.
Tyler, Ephraim Shaw,	Bridgeton,	N. J.	W. A. Rumsey.
Ulrich, Ralph Thomas,	Manheim,	Pa.	Dr. E. E. Gibble.
Waldenberger, William,	Manayunk,	Pa.	Louis Waldenberger
Walther, Phillip,	Meadville,	Pa.	V. W. Eiler.
Weidemann, George Buzby,	Philadelphia,	Pa.	Dr. C. A. Weidemann.
Weigester, Wilson,	Troy,	Pa.	Carpenter & Pierce.
Welch, William Herbert,	Frankford, Phila.,	Pa.	M. J. Wilson, M.D.
Williams, Morrison Patton,	Charlotte,	N. C.	Shinn & Baer.
Wilson, Oscar Herman,	Frankford, Phila.,	Pa.	R. J. Siegfried.
Winkler, Max Edwin,	Philadelphia,	Pa.	O. C. Winkler.
Winstanley, John,	Germantown, Phila.,	Pa.	B. A. Wissler.
Wisegarver, Oscar Kline,	Quarryville,	Pa.	T. M. Rohrer, M.D.
Wollaston, Byron Parker,	Wayne,	Pa.	H. C. Hadley.
Woodill, Robt. Franklin,	Philadelphia,	Pa.	Chas. E. Keeler.
Worthington, Warren W.,	Philadelphia,	Pa.	Chas. H. Clark.
Ziegler, Chas. Norman,	Gettysburg,	Pa.	Lewis Genois.
Ziegler, Wm. Lodge,	Steelton,	Pa.	W. L. Ziegler.

THIRD YEAR CLASS LIST.

Name.	*Place.*	*State.*	*Preceptor.*
Anstock, Arthur David,	Mahanoy City,	Pa.	E. M. Platt.
Alden, Harley Roscoe,	Auburn,	Me.	Dr. A. T. Pollard.
Barnett, Eldredge Ewing,	Cape May City,	N. J.	D. C. Guthrie.
Bell, Robert Nevens,	Kearney,	Neb.	S. A. D. Henline.
Bender, Arthur Clarence,	Shenandoah,	Iowa.	D. Ford Barr.
Benner, Fredk. James,	Bethlehem,	Pa.	Paul Kempsmith.
Boesch, Theodore Karl,	York,	Pa.	A. H. Lafean & Bro.
Boltz, Paul Kline,	Lebanon,	Pa.	E. K. Boltz.
Bosler, Harry Ellis,	Olean,	N. Y.	J. C. Welch.
Boysen, Theophilus H., Jr.,	Egg Harbor,	N. J.	Dr. T. H. Boysen.
Branin, Manlif Lewis,	Millville,	N. J.	C. B. McLaughlin.
Brenner, Frederic A.,	Kylertown,	Pa.	Lawson C. Funk.
Buckman, William Watson,	Newtown,	Pa.	Harry Cox.
Cather, Frank L.,	Chester,	Pa.	L. J. Farley.
Collins, Lane Verlenden,	Gloucester,	N. J.	John A. Frey.
Cone, Earl Hobart,	Batavia,	N. Y.	W. S. & J. J. Patterson.
Converse, Howard R.,	Picture Rocks,	Pa.	Moyer Brothers.
Davis, William Brown,	Kingston,	Pa.	W. H. Breisch.
Doan, Chester Clayton,	Coatesville,	Pa.	W. E. Lee.
Dunn, Edwin Alfred,	Meadville,	Pa.	P. H. Utech.
Eckels, Paul,	Decatur,	Ill.	C. A. Eccles.

Name.	*Place.*	*State.*	*Preceptor.*
Eddy, Roswell Martin,	Philadelphia,	Pa.	H. C. Eddy.
Eppler, George Theodore,	Philadelphia,	Pa.	E. E. Wilson.
Fegley, Florence Augusta,	Allentown,	Pa.	Fegley Bros.
Fegley, John Stauffer,	Allentown,	Pa.	Fegley Bros.
Fischer, Adolph Gustav,	Philadelphia,	Pa.	Albert Oetinger.
Fisher, George Calvin,	Philadelphia,	Pa.	E. K. Fisher.
Fleming, Samuel Clarkson,	Philadelphia,	Pa.	J. C. Perry.
French, Rolland Hall,	Salem,	Ohio.	Bolger & French.
Garber, Elmer Franklin W.,	Mt. Joy,	Pa.	Howard Smoker.
Gleim, Harry Charles,	Hazleton,	Pa.	McNair & Hoagland.
Goodyear, Harry Jacob,	Cornwall,	Pa.	L. Lemberger & Co.
Graham, Willard Rice,	Philadelphia,	Pa.	Smith, Kline & French Co.
Harbord, Kittie Walker,	Salem,	Ore.	Danl. J. Fry.
Harris, Wm. K. Garfield,	Altoona,	Pa.	A. F. Shimberg.
Hassinger, Samuel Reed,	Philadelphia,	Pa.	S. E. R. Hassinger.
Haydock, Mabelle,	Philadelphia,	Pa.	Susanna G. Haydock.
Headings, Prestie Milroy,	Reedsville,	Pa.	J. C. Perry.
Highfield, Herbert Monroe,	Zanesville,	Ohio.	Bailey Drug Co.
Hoffert, Charles Edward,	Lancaster,	Pa.	Chas. E. Keller.
Hoffman, Ira Calvin,	Scalp Level,	Pa.	H. B. Heffley.
Houston, Franklin Paxson,	Philadelphia,	Pa.	R. T. Young.
Hubler, Guy Garfield,	Gordon,	Pa.	J. E. Gregory.
Jetton, James Stuart,	Dyer,	Tenn.	Hayes & Griggsby.
Klopp, Edward Jonathan,	Reading,	Pa.	H. C. Blair.
Knerr, Charles George,	Allentown,	Pa.	G. W. Shoemaker & Co.
Kraus, Otto Louis,	New Haven,	Conn.	Otto Kraus.
Lacy, Burdet Seldon,	Philadelphia,	Pa.	Harry Cox.
Leib, Wilbur John,	York,	Pa.	John P. Frey.
Leiby, Howard Edward,	Ashfield,	Pa.	F. G. Mumma.
Levering, John H.,	Norristown,	Pa.	Eugene Fillman.
Lewis, Fielding Otis,	Hebbardsville,	Ky.	R. M. McFarland.
Liebert, Louis Williams,	Philadelphia,	Pa.	Dr. Thos. H. Price.
Luebert, Fred'k George,	Philadelphia,	Pa.	E. F. G. Mickley.
Luddy, James D.,	Chestnut Hill, Phila.,	Pa.	F. P. Streeper.
McClintock, Geo. Washington,	Key West,	Fla.	H. C. Blair.
McClurg, Benjamin Hoffer,	Elizabethtown,	Pa.	Alfred H. Bolton.
McDermott, Rob't Joseph,	Trenton,	N. J.	A. S. Wickham.
McFadden, Warren Lester,	Williamsport,	Pa.	Duble & Cornell.
MacPhee, John James,	Glasgow,	Nova Scotia.	F. D. MacPhee.
Mauger, Harry Filman,	Pottstown,	Pa.	J. D. Seiberling.
Metcalfe, Hiram Kennedy,	Greencastle,	Pa.	Sands Drug Co.
Michels, Victor Clyde,	Albion,	Ill.	B. F. Michels.
Murphey, Edwin Mason,	Macon,	Miss.	T. S. Murphey.
Musser, Guy Musselman,	Witmer,	Pa.	R. W. Cuthbert, Ph.G.
Nauss, George Hill,	Steelton,	Pa.	W. K. Martz.
Penrose, Thomas William,	Philadelphia,	Pa.	F. W. E. Stedem.
Picking, Jacob Sylvester, Jr.,	Somerset,	Pa.	Dr. F. C. Kress.
Pittinger, Charles A.,	Freehold,	N. J.	Edward G. Bacon.
Pflieger, Adam William,	York,	Pa.	A. L. Ziegler.
Pollins, Harry George L.,	Greensburg,	Pa.	S. P. Brown.
Post, Arthur Edward,	Towanda,	Pa.	F. E. Post.
Raser, Wm. Heyl,	Reading,	Pa.	John B. Raser.
Reynolds, Clarence Hyatt,	Reynoldsville,	Pa.	S. Reynolds, M.D.
Rhoads, Luther K.,	Reading,	Pa.	C. H. Randenbush.
Rinker, William,	Hellertown,	Pa.	F. E. Jacobson.
Roberts, Geo. William,	Philadelphia,	Pa.	Dr. J. L. Sands.
Rogers, Walter Clyde,	West Chester,	Pa.	Frank P. Rogers.
Ryan, Thomas A.,	Susquehanna,	Pa.	Dr. W. S. Mitchell.
St. Jacques, Gaston,	St. Hyacinthe,	Canada.	Dr. E. St. Jacques.
Saul, Irvin Ellsworth,	Windsor Castle,	Pa.	Jesse W. Pechin.
Schmerker, Adolph Alex. B.,	Allentown,	Pa.	J. L. Crothers.

Name.	*Place.*	*State.*	*Preceptor.*
Schneider, Emil Sebastian,	Philadelphia,	Pa.	Philip Goll.
Schooley, Joseph Griggs,	Montgomery,	Pa.	T. W. Strank.
Scott, Henry William,	Waynesburg,	Pa.	Dr. Brock.
Shafer, Clarence Eugene,	Altoona,	Pa.	H. L. Stiles.
Shannon, Byron Guest,	Philadelphia,	Pa.	A. C. Schofield.
Shaver, David Oscar,	Altoona,	Pa.	F. L. Akers.
Sheffer, William Walter,	Dillsburg,	Pa.	Lawson C. Funk.
Shenkle, Albert Philip,	Phœnixville,	Pa.	M. R. Shenkle.
Shields, Percy Way,	West Chester,	Pa.	W. W. Bowman.
Skillman, Lionel Gilliland,	Philadelphia,	Pa.	Shoemaker & Busch.
Slocum, Chas. Eben,	Ouray,	Col.	C. C. Stratton.
Spears, Edward Gibson,	Reading,	Pa.	Harry H. Kline.
Steever, Wm. Forsaith,	Millersburg,	Pa.	C. E. Steever.
Stoudt, Irwin Sylvester,	Obold,	Pa.	Wm. Proctor, Jr., Co.
Stout, Benjamin Franklin,	Quakertown,	Pa.	N. S. Steltzer.
Strathie, Alex. John,	Sussex,	England.	Wm. J. Jenks.
Texter, Charles Henry,	Perkasie,	Pa.	Harry Neamand.
Tingle, John Beard,	Dayton,	Ohio.	E. M. Boring.
Urffer, Samuel,	South Bethlehem,	Pa.	H. W. Sheets.
Van Gilder, Levi,	Petersburg,	N. J.	George J. Pechin.
Walker, Joseph Franklin,	Bridgeport,	Pa.	
Watson, Herbert James,	Wilmington,	Del.	H. K. Watson.
Wolfer, William Conrad,	Philadelphia,	Pa.	Edward C. Stout.
Wolfinger, John Philip,	Reading,	Pa.	H. J. Schad.
Ziegler, C. Harry,	York,	Pa.	Nelson B. Fry.

SPECIAL STUDENTS.

Name.	*Place.*	*State.*	*Department.*
Andrews, W. C.,	Woodstown,	N. J.	Chemistry.
Boss, A. C.,	Philadelphia,	Pa.	Chemistry.
Capwell, H. M.,	Philadelphia,	Pa.	Chemistry.
Carter, F. P.,	Philadelphia,	Pa.	Chemistry.
Cavanaugh, F. A.,	Ashbourne,	Pa.	Chemistry.
Cone, Earl Hobart,	Batavia,	N. Y.	Chemistry.
Cooney, Wm. Francis,	Florence,	Mass.	Chemistry.
Crawford, W. H., Jr.,	Ashbourne,	Pa.	Chemistry.
Dubbs, Carbon P.,	Pittsburg,	Pa.	Chemistry.
Ehman, J. W.,	Philadelphia,	Pa.	Chemistry.
Everham, Harry V.,	Ambler,	Pa.	Chemistry.
French, Rolland Hall,	Salem,	Ohio.	Chemistry.
Gagan, George,	Wilmington,	Del.	Chemistry.
Hoffman, N. B.,	Fairview,	Pa.	Chemistry.
Jaeger, W. C.,	Philadelphia,	Pa.	Chemistry.
Kane, J. K.,	Brooklyn,	N. Y.	Chemistry.
Lord, Geo. W., Jr.,	Haddonfield,	N. J.	Chemistry.
McMahon, Joseph Alphonsus,	Lock Haven,	Pa.	Chemistry.
Michels, V. C.,	Albion,	Ill.	Chemistry.
Pitts, M. W.,	Lynn,	Mass.	Chemistry.
Roberts, John Austin,	Wilmington,	Del.	Chemistry.
Staley, F. W.,	Middletown,	Pa.	Chemistry.
Stolz, Louis,	Syracuse,	N. Y.	Chemistry.
Suess, Ignatz,	Gr. Meseritch,	Austria.	Chemistry.
Smith, F. D. G., Ph.G.,	Grand Fords,	N. D.	Chemistry.
Thompson, Samuel,	Germantown, Phila.,	Pa.	Chemistry.
Walker, J. T.,	Bridgeport,	Pa.	Chemistry.
Whitaker, W. E.,	Frankford,	Pa.	Chemistry.
Winters, O. E.,	Germantown, Phila.,	Pa.	Chemistry.